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ABSTRACT

Addressing the problems of rural housing site selection and development in North Carolina, this guide is designed for cooperative and coordinated use by: technical assistance personnel employed by the Farmers Home Administration; local lending institutions; Health Departments; the Agricultural Extension Service; the Soil Conservation Service; and real estate and housing developers. Presenting various kinds of maps, charts, tables, diagrams, and illustrations, this manual addresses the following specific areas of concern: (1) Site Selection (preference area; priority group determination; soils investigation; ground water availability; land parcel investigation; investigation of the priority site; purchase of the site); (2) Site Test (suitability for septic tanks; suitability for foundations; slope suitability; erosion management suitability; depth to bedrock; no potential flooding; ground-water level suitability); (3) Site Development (property survey; locating the well; slope analysis; locating the driveway on the site; locating the house; locating activity areas; locating other site facilities; grading the site; post conclusion planning); (4) Appendices (North Carolina laws on site development and a list of site development information sources). (JC)

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preface

When the director of the Macon County Program for Progress contacted the University in 1970 with a request for assistance in developing standardized housing for a self-help program, a team was assigned the task of exploring the problems related to providing adequate housing in the mountains of our state. Although there was a need for standardized mountain housing types, we soon discovered a wide range of site-related problems—nonfunctioning septic tanks, inadequate water supplies, eroding yards, drives too steep to accommodate automobiles, cracked foundation walls, and costly cut-and-fill operations.

Most of these problems were the results of improper site selection and development practices. Although these were not the only problems in improving the quality of mountain rural housing, they were among the major obstacles both to the low and moderate income families as well as second home builders. It is to these problems of site selection and development that this manual is directed. The process herein recommended represents the combined effort of the University and the various public agents in the field (in what is called an interdisciplinary effort to the former and old-fashioned cooperation to the latter). This manual relies heavily on techniques used by various grass roots agents for years. But what is new is the combined and coordinated processes and the techniques that should make it easier to better choose and more cheaply develop a housing site within sound environmental standards.

Although originally designed for use in the mountains, this manual is generally applicable to all the rural regions of the state; that is, the piedmont and the coastal plain in addition to the mountains. Generally we believe the process for site selection and development can be the same throughout the state. But the priority criteria may vary from one region to another. Slope, flooding and ground water availability as well as other characteristics vary greatly throughout the state.

The intent is that the process described and information provided be utilized by technical assistance personnel employed by the Farmers Home Administration, local lending institutions, Health Departments, the Agricultural Extension Service, the Soil Conservation Service, and real estate and housing developers. Through their cooperative effort we believe higher quality rural housing can be produced.

It should be mentioned that as we have developed this manual, our research has indicated that clustered housing in planned unit developments would be more environmentally sound than scattered single family housing. But because there is such a strong user preference for scattered rural housing in North Carolina, we believe we should assist in improving scattered rural housing through site planning within the guidelines set by the state and the potential users.

Randolph T. Hester, Jr.
Woodley C. Warrick

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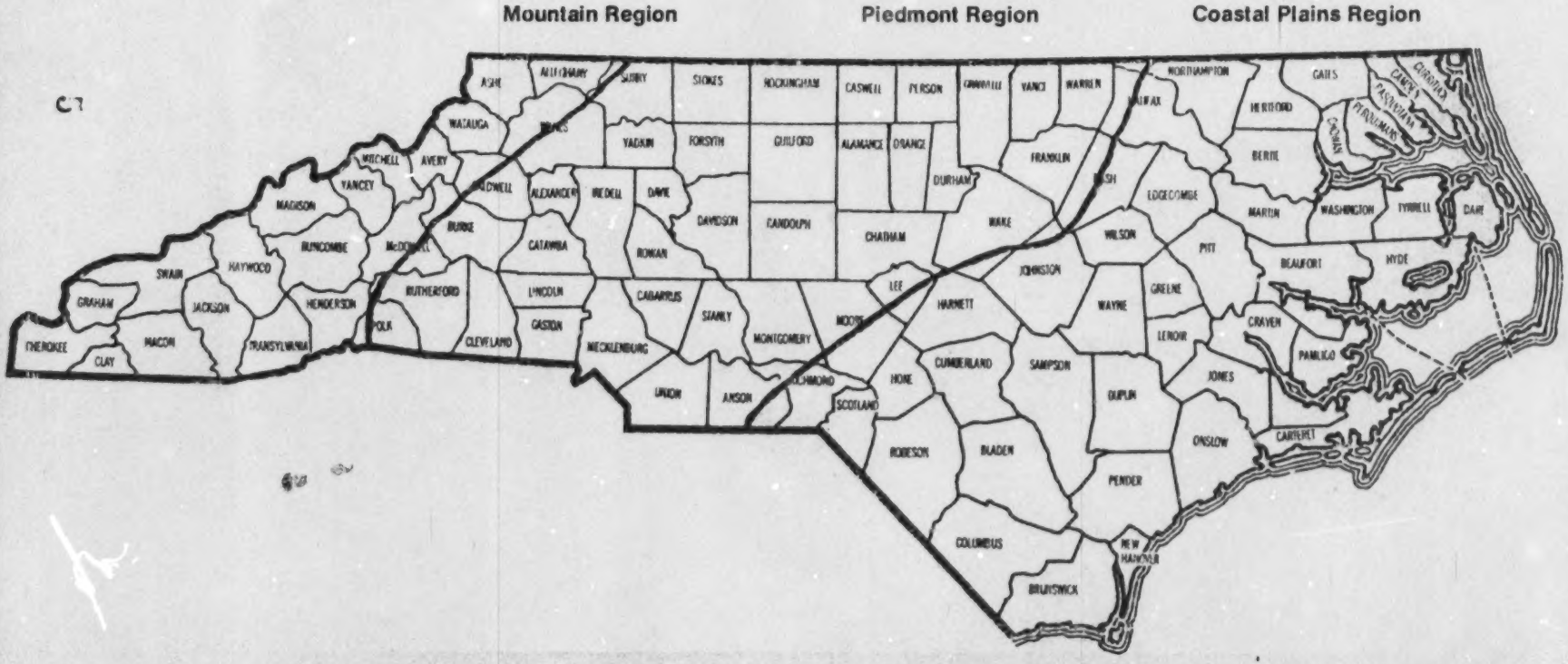
Physiographic Regions In North Carolina

Distinctions between physiographic regions relate to the type of underlying rock, soil type, elevation and slope and do not necessarily follow county lines.

Generally, criteria for site selection and site development are much the same for the mountain and piedmont regions, although in the mountain region excessive slope is a greater problem on a greater percentage of available lots. For the coastal plain region, the criteria of flooding, ground water, supply and slope are unique to that region and proper site planning must be related to these basic criteria.



introduction

This manual illustrates a preference procedure for selecting and developing a building site for a family that plans to purchase a lot and have a house built on it.

The series of steps in this site planning process should facilitate the selection of a site from those available and its development to meet the needs of a family. There are many physical aspects of lots that can be given relative numerical values for comparing different lots. Further considerations relate to family economics and family social values. All these elements should be considered by the family.

It is difficult to assist a family with putting a scale on social values, but if the economic and physical aspects can be determined, it should be easier for a family to make a final decision.

To illustrate the site planning process, the Smith family is selected to follow through the steps. Mr. Smith, who is head of the family, desires to live within two miles of his work in Macon County, which is in the mountain region. In the site planning process outlined, Mr. Smith is assisted with the selection and purchase of a site suited to his family's physical, economic and social needs and with the development of the site. Through following this process the family's needs for a suitable building site will be met and harm to the environment will be lessened.

site selection

preference area

Location of Preference Area

The first step in the site-planning process involves determining where in the county the client would like to live. Familiarity of the client with the county will greatly aid him in determining a preferred area. If he is a native he will, no doubt, have a specific area in mind based on his personal preferences. For example, he will probably determine the area in which he desires to live based on the location of work, churches, schools, family, friends, etc.

A poor location can result in great dissatisfaction in family living. A rule of thumb for acceptable distances from the home to church, high school, elementary school, local shopping centers and major shopping centers is difficult to establish for rural families living on scattered sites. Most families prefer that children spend as little time as possible traveling back and forth to school. Often shopping preference sites for rural families, and some clients may not object to traveling up to 40 miles or more to work.

If a person is looking for a vacation home site, he will most likely want a site which can provide him with privacy, esthetic views, recreation, etc. Nearness to shopping, schools and churches is of less value for a second home than for a primary home.

Example

Mr. Smith, representing the family in the illustration, has determined that the most important consideration for the location of his home is for it to be located within 2 miles of his place of work. Second, he indicates that the locations should be within 2 miles of his family's farm and within 3 miles of an elementary school. Mr. Smith also desires to live within ½ mile of a highway or adequate hard-surface road. Mr. Smith indicated the average number of trips per week to the first three locations. This aided him in determining the maximum desired distance he desires to live from the locations. He also indicated that he does not own a homesite now and is definitely interested in finding a site and building a home.

Locational Preference Ranking

Priority Determinants		Trips Per Week	Maximum Distance
No. 1	Work	5	2 miles
No. 2	Family Farm	2	2 miles
No. 3	School	5	3 miles
No. 4	Highway		½ mile

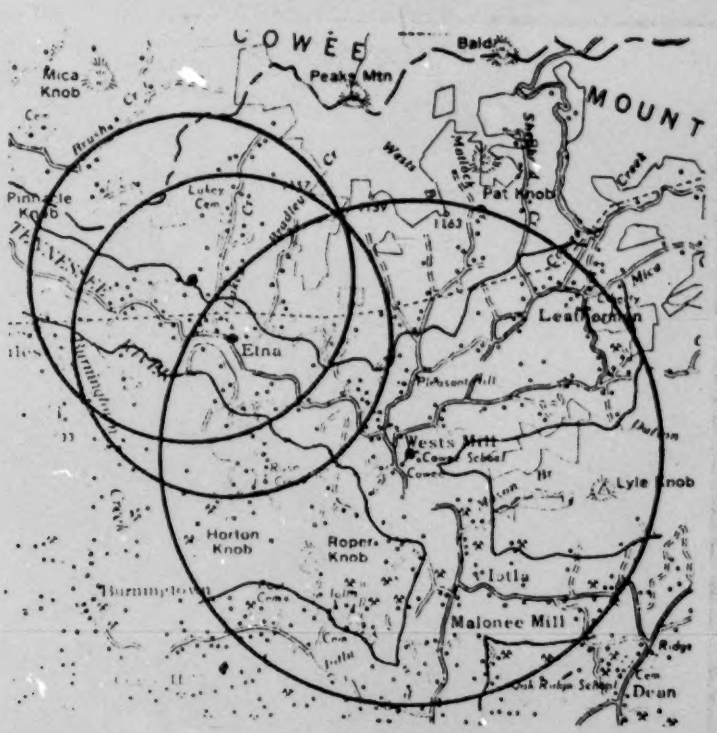
Mapping of Preference Area

1. Locate the order of preference items on a county road map (one inch equals one mile) or on a United States Geological Survey map. The latter map is a 7½-minute map (quadrangles covering 7½ minutes of latitude and longitude are published at the scale of 1 inch = 2,000 feet).

2. Draw circles around these points with the radius equal to the maximum desired distance.

3. Shade in the area where the circles tend to overlap. If they do not overlap then the client should adjust the maximum desired distances. The circles will not always clearly overlap, so the preference area should be determined with consideration to the preference rank.

On the county map, Mr. Smith has located his place of work in Etna (map A left) and his family's farm to the northwest of Etna. The nearest school has been located, the Cowee School. A circle with a two-mile radius (the maximum desired distance) has been drawn around both his place of work and his family's farm. A circle with a three-mile radius has been drawn around the Cowee School. Dashed lines have been drawn ½ mile on either side of the road.



Map A
Mr. Smith's locational preferences have been located, the radii set and the adjacent highway located.

Note:
County road maps can be obtained from the North Carolina Highway Commission, North Carolina Highway Building, Raleigh, NC. U.S. Geological Survey maps are available from the Distribution Section, U.S. Geological Survey, 1200 South Eads Street, Arlington, VA 22202, for 75¢ a copy. Order map by using an "Index to Topographical Maps of North Carolina" available free from the U.S. Geological Survey. This index lists also 11 dealers in North Carolina who sell the U.S. Survey maps.

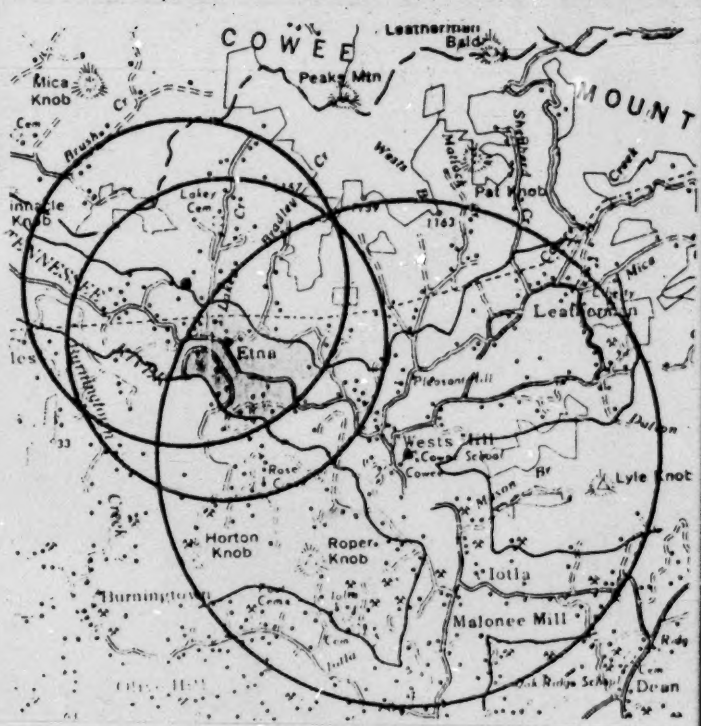
In the second chart (map B right) the land area which is in each of the circles and also within ½ mile of the highway has been located. This area has been shaded. This is Mr. Smith's preference area for the location of his home.

priority group determination

The purpose of step 2 is to correlate house and site development cost to family income. Within the preference area there will most likely be a variety of sites. The soil conditions, the land slope and the availability of ground water may vary greatly within the area. Families with limited financial resources should select a site within the area which is less costly to develop and maintain. For such the financial resources of the family must be determined.

A family that has financial resources for priority Group I should consider the least costly site to develop and maintain. Families with above moderate resources can afford a Group II site which would be more expensive to develop and maintain. Those with unlimited resources can select a priority Group III site with even more natural obstacles to develop and maintain because they can afford to pay for the cost of specialized systems needed in these adverse circumstances.

There may be situations that are exceptional to this general guide. For example, the sale price of a site may be lowered sufficiently, because of objectionable physical characteristics, to warrant spending more money in developing it. The total cost of the site and its development would then be within reason or no greater than the total cost of a lot with less expensive development requirements.



Map B
The shaded area is located where the circles overlap and within ½ mile of the highway. This is Mr. Smith's preference area.

Site Priority Group	Family Financial Resources	Cost of House and Site Development
I	Low to moderate	to $19,999
II	Above moderate	$20,000 to $29,999
III	Unlimited	$30,000 and up

Determining the Amount One Can Pay for a House

The amount one can pay for a house and lot if secured with a loan depends on three important factors: (1) the amount of monthly house payments one can afford, (2) term or length of the loan and (3) the interest rate. The amount of house payment a family can make depends on the level of income, number of dependents, family financial management and other related factors. Generally, the larger the family income, the higher the monthly payment and the higher the proportion of a family's income which can be allocated to housing. As the term of the loan increases, one can increase the amount one can pay for a house. But, for a given rate of interest, the longer the term of one's loan the more the total amount of interest one has to pay. The amount one can pay for a house varies indirectly with the rate of interest one has to pay. That is, the higher the rate of interest the less one can afford to pay for a house with a given income and given term for the loan.

The formula for determining the amount one can pay for a house and lot (assuming no subsidy) is as follows:

$$M = KY) \frac{1 - \frac{1}{(1+i)^n}}{i}$$

where:

M = Maximum amount of mortgage which can be secured and repaid
K = Proportion of family income which can be allocated to principal and interest payment on housing
Y = Monthly family income
i = Annual interest rate computed on monthly basis
n = Length of loan in months (number of monthly payments)

To simplify computation, coefficients for the expression

$$\frac{1 - \frac{1}{(1+i)^n}}{i}$$

in the above equation have been computed for selected interest rates *i* and selected terms of loans *n*. *Each coefficient in the accompanying Table indicates the amount one can afford to pay for a house and lot secured by a mortgage loan for each dollar of monthly payment one can make on principal and interest for a specific interest rate and specific term for the loan.* For example, if the interest rate is 8 percent and a loan is secured for a period of 30 years, one could buy a house and lot costing $136.28 for each dollar of monthly payment on principal and interest. If one could make $100 monthly payments, one could repay an 8 percent mortgage loan for 30 years of $13,628 ($100 x 136.28).

Thus: M = KY times appropriate coefficient in the Table corresponding to the prevailing interest rate and time period of the mortgage loan. As *K* or *Y* increases, the family can buy a more expensive house, assuming the interest rate and term of the loan remain constant.

Example of How to Use the Table

The Smiths have a monthly family income of $650. Assuming the Smiths can allocate 18 percent of their income, or $117 per month payment, to principal and interest and the annual rate of interest is 8½ percent, they could afford to pay $14,530 for a 25-year loan ($117) (124.19); $15,215 for a 30-year loan ($117) (130.05); and $15,665 for a 35-year loan ($117) (133.89).

Assuming the same interest rate of 8½ percent, 18 percent of family income allocated to housing, and a family income of $775 per month, approximately the median family income in the state, the family could afford to pay $17,322, ($775 x .18 = $139.50 monthly payment times 124.19), for a house financed for 25 years and $18,678, ($139.50 monthly payment times 133.89), for a house financed for 35 years.

Taxes and insurance are not taken into consideration in the above calculations. A rough approximation for taxes and insurance is 1.25 percent of the total value of house and lot in a rural area. These costs should be considered along with the costs of utilities when assisting families in estimating the proportion of their income which they can allocate to payments on principal and interest.

Because of their limited resources, the Smith's should be encouraged to select a site which is the least expensive to develop (Priority Group I).

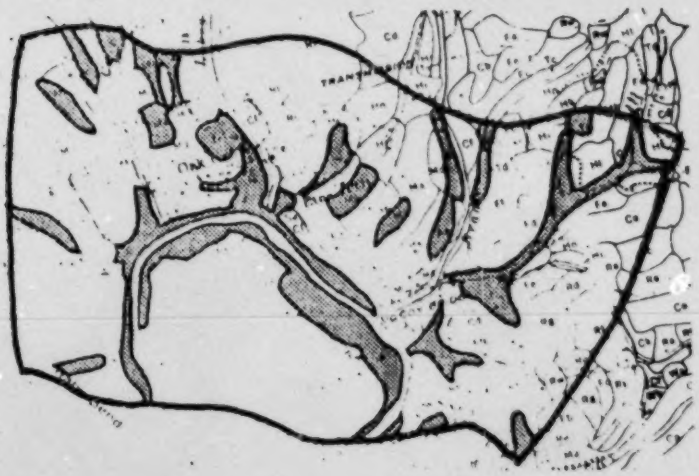
When selecting a lot or site on which to build, consideration should be given to any costs required to get the site ready for construction and the maintenance costs which may be expected to occur over time.

Interest Rate (Percent)	Term (years)						
	10	15	20	25	30	35	40
6	90.07	118.50	139.58	155.20	166.79	175.38	181.75
6.5	88.07	114.79	134.12	148.10	158.21	165.52	170.81
7	86.13	111.25	128.98	141.49	150.30	156.53	160.92
7.5	84.24	107.87	124.13	135.32	143.02	148.31	151.96
8	82.42	104.64	119.55	129.58	136.28	140.80	143.92
8.5	80.65	101.55	115.23	124.19	130.05	133.89	136.41
9	78.94	98.59	111.14	119.16	124.28	127.55	129.64
9 9.5	77.28	95.76	107.28	114.45	118.93	121.71	123.44
10	75.66	93.06	103.09	109.89	113.63	116.27	117.76

Amount One Can Pay for a House and Lot Per Dollar of Monthly Payment on Principal and Interest for Selected Terms and Interest Rates

DESIRABLE SOIL STANDARDS*

Criteria	Priority Group I	Priority Group II	Priority Group III
Percolation	Well-drained	Moderately well-drained	
Flooding	None	None	Rare or occasional
Slope			
Mountain	0-8	8-25	Over 25
Piedmont	0-8	8-15	Over 15
Coastal Pl	½-8	Over 8	Less than ½
Shrink-Swell	Low	Moderate	High
Depth to Bedrock	Over 6'	Over 3'	Less than 3'
Erosion	Slight	Moderate	Severe



soils investigation

The various soil types have been studied in regard to the flooding potential, the shrinkswell potential, the depth to bedrock, the land slope, the percolation rate and the conservability (in terms of erosion) of the soils. The soil types in the county that are suitable for building have been grouped into the three priority groups as discussed in step 2.

The soils maps and a list of those soils suitable for each priority group are available through the local Soil Conservation Districts. Using the SCS map, follow a three-step procedure, as follows:

1. The preference area, step 1, should be located on the county soils map.

2. Those soils suitable for the client's priority group should be located within the preference area.

3. The soils of his priority group should be shaded to delineate the areas.

Example

Since Mr. Smith is in priority Group I, the selected soils within his preference area should be suitable for soils priority Group I. The soils codes for Mr. Smith are: As, Ao, Cp, Cr, Hy, H3, Mb, Me, Sb, Sa, Sc, Tc, Tg, Td, Tn, Tl, Tu and Tr. The soils with these codes have been located in Mr. Smith's preference area on the soils map (left). The suitable soil areas are shaded in the example. Thus the areas suitable for sites for Mr. Smith have been reduced to the shaded areas.

Sites with Priority Group I soils are indicated on this SCS soils map.

*For further assistance, consult: S.C.S. Technical Guide, Section II-B., "Guide for Interpreting Soils."

ground water availability

Because the ground water investigations involve rural areas which do not have community water services, it is very important that a single family homesite be able to accommodate its occupants with a desirable yield of quality water. Ideally, a single family home well should be located in an area in which yields of 10 or more gallons of water per minute may be obtained. However, many families find that they can manage adequately with as little as 5 gallons per minute.

A ground water map for the state has been provided as a general guide (map 1). However, more detailed county geologic maps should be obtained in the ground water bulletins published by the State Ground Water Division in Raleigh. The bulletins discuss many important topics including regional ground water occurence and quality. They also provide an information summary of wells previously constructed in the area. These bulletins should be used in the well site selection process. An index map (map 2) showing those regions of the state covered by the various bulletins is provided.

The following table specifies the desirable standards of water quantity and quality for each priority group. This table should be used in conjunction with the county geologic map and regional ground water bulletin.

DESIRABLE WATER STANDARDS

Criteria	Priority Group I	Priority Group II	Priority Group III
Water Quantity	5 Gal/Min	5 Gal/Min	5 Gal/Min
Well Depth	Less than 200 ft	Less than 200 ft	Less than 300 ft
Water Quality	Excellent to Good	Good	Fair to Good

Mapping the Desirable Areas

1. Locate the preference area on the county geologic map. Note: The ground water map is at a smaller scale than the soils map.
2. Determine which rock formations are within the preference area and determine their anticipated yields from the data provided in the ground water bulletins.
3. Within the preference area, determine areas of high water yield and of low water yield. Pay close attention to transitional areas between the two zones because the separation is not always precisely located.
4. Transfer and map any high, transitional, or low water yielding areas to the preference area on the soils map.
5. Check the data in regard to water quality for the area.
6. On the soils map, shade the areas that have suitable soils and that will also provide adequate yields of quality water. The shaded area at this point is termed the "target area."

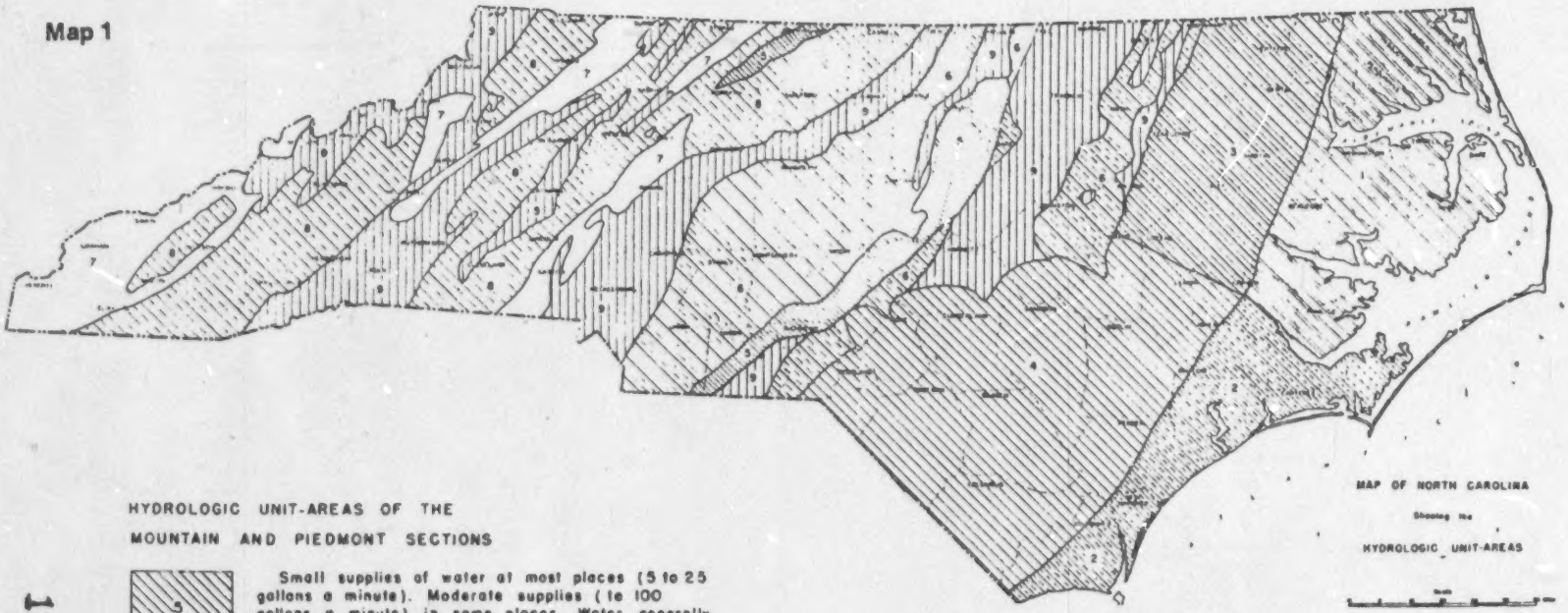
Example

Because Mr. Smith is in priority Group I, the desirable water standards are: a yield of at least 5 gallons of water per minute, a well less than 200 feet deep, and excellent to good water quality. Within Mr. Smith's preference area, there are two rock formations on the geologic map (map 3).

Mica schist is to the northwest portions and biotite gneiss is to the southeast portion of the preference area. The data indicates that mica schist yields, on an average, 5 to 20 gallons of water per minute, while biotite gneiss yields, on an average, 30 to 50 gallons of water per minute. The geologic map indicates that the biotite gneiss is much more suitable for adequate water yields, and especially for priority Group I.

On the soils map (map 4), the two lines have been drawn to generally delineate the high, low, and transitional yielding areas. The areas of suitable soils and also high water yields have been shaded. The shaded area is Mr. Smith's "target area."

Map 1



HYDROLOGIC UNIT-AREAS OF THE
MOUNTAIN AND PIEDMONT SECTIONS

5 — Small supplies of water at most places (5 to 25 gallons a minute). Moderate supplies (to 100 gallons a minute) in some places. Water generally moderately hard to very hard, sometimes contains objectionable amount of iron.

6 — Generally moderately small to moderate (10 to 50 gallons a minute), occasionally moderately large supplies (to 300 gallons a minute). Water frequently contains objectionable amount of iron.

7 — Generally moderate supplies of water. Wells yield from 5 to 50 or more gallons a minute. Water usually soft, except from wells in limestone.

8 — Moderate to moderately large amounts of water. Industrial and municipal wells average about 50 gallons a minute. Best supplies obtained in coarser phases where dip is fairly low. Water soft to moderately hard.

9 — Generally small, sometimes moderate, rarely moderately large supplies of water. Best supplies are from more highly metamorphosed rocks. Only a few gallons a minute from wells in unsheared rocks. Water moderately soft to hard.

HYDROLOGIC UNIT-AREAS OF
THE COASTAL PLAIN SECTION

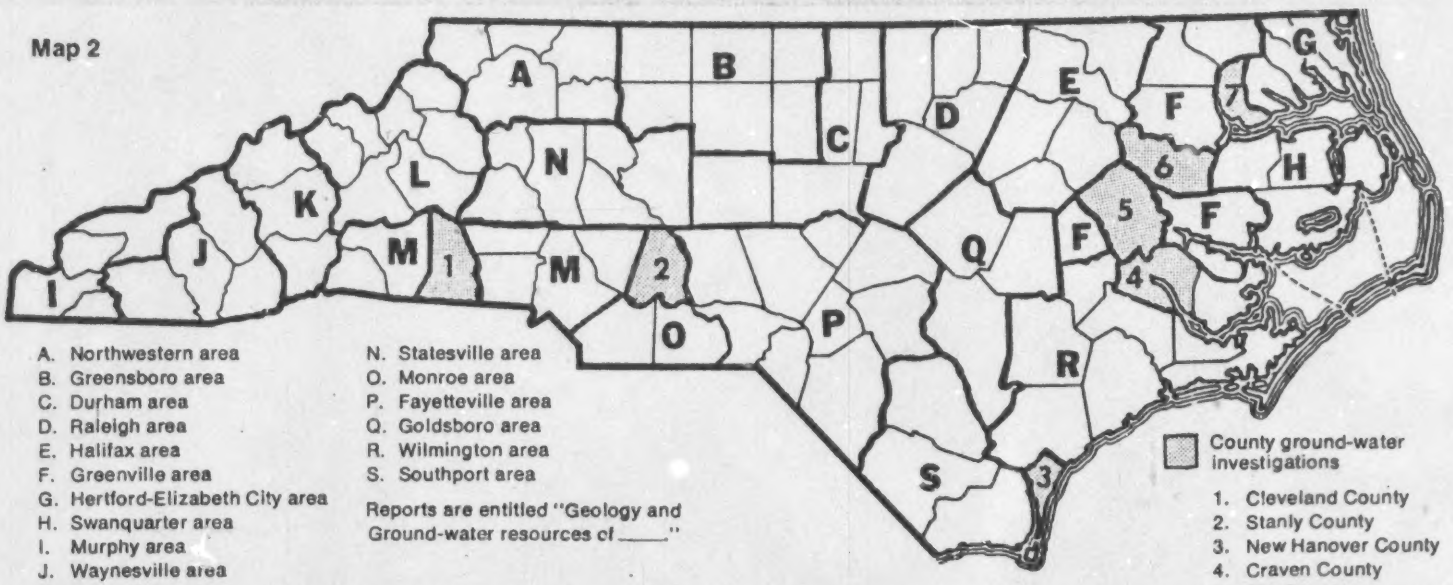
1 — Large amounts of water from wells 100 to 400 feet deep. Water is hard, at places contains objectionable iron. Deeper water is brackish.

2 — Very large amounts of water available in most parts. Wells yield up to 1000 gallons a minute. Water usually hard. Brackish water at depths of 200 to 600 feet below the surface.

3 — Large amounts of soft water available except along western margin of the area. Yields of 300 to 600 gallons a minute at many places.

4 — Large quantity of water available except in extreme western part. Yields of 500 gallons a minute possible at most places. Water soft, low in dissolved, solids, sometimes high in iron.

Map 2



A. Northwestern area
B. Greensboro area
C. Durham area
D. Raleigh area
E. Halifax area
F. Greenville area
G. Hertford-Elizabeth City area
H. Swanquarter area
I. Murphy area
J. Waynesville area
K. Asheville area
L. Morganton area
M. Charlotte area
N. Statesville area
O. Monroe area
P. Fayetteville area
Q. Goldsboro area
R. Wilmington area
S. Southport area

Reports are entitled "Geology and Ground-water resources of ____"

County ground-water investigations

1. Cleveland County
2. Stanly County
3. New Hanover County
4. Craven County
5. Pitt County
6. Martin County
7. Chowan County

GROUND-WATER INVESTIGATIONS COMPLETED AS OF JUNE 1972

This map was taken from "Water Resources Investigation in N. C. 1972"

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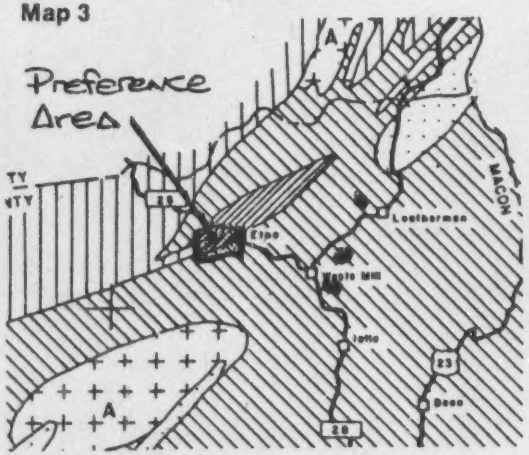
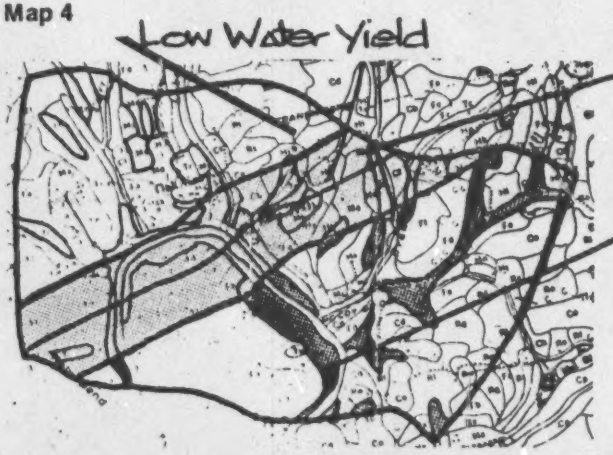
Map 3



Map 4



land parcel investigation

Through the previous four steps an area has been determined that satisfies the client's locational desires as well as provides the most suitable building areas. Within this target area, available land parcels should be investigated. It is not an easy task to be familiar with the available land parcels within the county. Land parcels can become available due to many situations. To be familiar with such changes one should make frequent inquiries of lawyers, accountants, realtors, Farmers Home Administration offices, Agricultural Extension agents, land owners, banks, savings and loan associations, etc. If no available land parcels can be located within the target area, then an adjustment should be made by the client in the preference area (Step I) so as to include a larger area.

Site Visits

When several possible land parcels have been located within the target area, visits should be made to each of the sites with the prospective new homeowner. Preliminary site investigations should be made during these visits. The investigations are grouped into three categories: (1) the client's preference, (2) the advantages of the site location and (3) the cost of the site, site construction and maintenance. Criteria with which to assess the sites are shown as a sample process which follows. One may wish to include other criteria. Each site should be investigated and ranked for each of the criterion from the most desirable to the least desirable site.

Ranking the Sites

For each of the criterion a top-ranked site should receive three points; a second-ranked site, two points; and a third-ranked site, one point. All the sites may be considered top-ranked sites for some criteria, thus each should receive three points. This ranking procedure only establishes the best site from among those visited. It does not in itself indicate that the top-ranked site is necessarily a good site, for all the sites visited may be somewhat unsatisfactory.

In some cases, the entire process in this manual may not be utilized in the format provided. Some advisors may adjust the steps to more accurately meet the client's particular needs and should do so. For instance, the site-ranking criteria above can be utilized as a handy checklist or reminder when investigating a site even if the target area has not been determined.

Example

Three land parcels, or sites, have been located for Mr. Smith within the target area. Mr. Smith accompanied the agent to each of the sites. When they were on a site they went over the list of criteria and made notes. After they had visited all three sites, they ranked the sites and gave the sites the following points: Site A totaled 36 points; Site B totaled 33 points; and Site C totaled 30 points. Based on these points, Site A with 36 points is the choice site for Mr. Smith.

Criteria for Site Visits (Preference Scale: 1. Good. 2. Better. 3. Best. Highest points indicated highest perference.)

Client's Preferences (or Ranking of Sites Considered)	Site A	Site B	Site C	Site D	Site E	Notes
1. Consider the scenic qualities of the site. Most desirable.	3	2	2			
2. Consider the ease of maintenance of the site (ex. mowing grass). Easiest to maintain.	2	3	3			
3. Consider a site with limited rock out-croppings. The fewer outcroppings, the better. In eastern N.C. consider the soil drainage.	2	2	2			
4. Determine the boundaries of the site, and assess the amount of usable yard space available.	3	2	3			
5. Other criteria, including nearness to relatives, friends, church, schools, shopping, etc.	1	3	2			
Site Location Advantages	**Site A**	**Site B**	**Site C**	**Site D**	**Site E**	**Notes**
1. Consider the distance from the site to available hard-surfaced roads. Close to roads?	3	2	2			
2. For mountainous areas choose either (use the same side for each site): a. sites on south slopes - warmer in winter b. sites on north slopes - damper and colder in winter, but pleasant in summer	Does not apply on these three sites, all east-west slopes.					
3. Possible house orientation. a. solar orientation. b. direction of prevailing winds.	3 3	3 2	2 3			
4. Consider the present and potential adjacent land uses. Complementary and stable.	3	3	1			
5. Other criteria						
Site Construction and Maintenance Costs	**Site A**	**Site B**	**Site C**	**Site D**	**Site E**	**Notes**
1. Determine the site cost. Least expensive.	3	2	3			
2. Determine the average slope across the site. Least sloping.	2	3	2			
3. Consider a site with no major drainage ways crossing the property. No major drainage ways.	3	2	1			
4. Assess the amount of vegetation cover on the property. Ample vegetation.	3	1	2			
5. Consider a site that does not have easily erodible soil (check for signs of erosion). Little erosion.	2	3	2			
6. Other criteria. TOTALS	36	33	30			

PREFERENCE SCALE

X = Unacceptable 1 = Good 2 = Better 3 = Best

Criteria	First Choice	Second Choice	Third Choice
Suitability for septic tank sewage disposal system	3	2	
Suitability for foundation	3	3	
Slope suitability	3	2	
Erosion management suitability	3	2	
Depth to bedrock suitability	X	3	
No potential flooding	3	3	
Ground-water level suitability	3	2	
TOTAL	18	17	

investigation of the priority site

After the priority site has been selected, tests should b carried out on the site *before* the purchase of the propert is made. The items to be tested for suitability include:

1. Septic tank sewage disposal system
2. Foundation
3. Slope
4. Erosion management
5. Depth to bedrock
6. No potential flooding
7. Ground-water level

Each of these tests is explained in detail in Section I "Site Test." These site tests must be completed in order t make a valid test of the site's suitability.

The site should meet the standards of each of the test before the property is purchased. However, if one or two o the test results are not satisfactory, some alternative migh be investigated. For example, if suitability for foundation is poor, then an alternative type of foundation construction might be utilized. If an alternative method is investigated, its cost should be clearly assessed.

If the test results and any alternatives are unsatisfactory then the second priority site should be investigated, which also would entail the completion of the site tests. If none o the sites is suitable, then other sites should be located a in step 5, with an increased preference area, step 1.

Example

The site tests were completed for Mr. Smith's priority site. The site was found to be unsatisfactory because of high bed- rock level (the site was covered with bedrock within 4 feet o the soil surface). Site B, the second priority site, was investi- gated and found to be satisfactory according to all the site tests. Mr. Smith can now proceed with action leading t purchase of the site.

purchase of the site

With the satisfactory completion of the site tests and the approval of the client, the purchase of an option to purchase the property can be made. Because the availability of water cannot be assured without test drillings and because the cost of a well becomes excessively high when the depth of the well exceeds 100 feet, the best procedure is to include in the purchase contract a water-availability clause. This clause should stipulate the rate of discharge at a specific depth and the number of drillings to obtain quality (specify standards) water.

Example

Because Mr. Smith has limited finances, he must be quite sure that the well to be drilled will yield an adequate flow on the first drilling. Since there is no way to be sure of a successful drilling, a water clause has been included in his contract.

The third section of this manual, which follows the section on site tests, pertains to site, driveway location, well location, development of a site plan, etc. - all prior to construction of the house, as well as other necessary steps for the completion of the site during and after construction.

Position 5

Form FHA 440-34
(Rev. 9-14-70)

UNITED STATES DEPARTMENT OF AGRICULTURE
FARMERS HOME ADMINISTRATION

OPTION TO PURCHASE REAL PROPERTY

I. In consideration of the sum of $ 100.00 [illegible] sufficiency of which are hereby acknowledged, the undersigned [illegible] the owners thereof, hereby [illegible] to sell and convey to

J.B. SMITH, ETNA, MACON COUNTY, NORTH CAROLINA

Name and Address

(hereinafter called the "Buyer"), and hereby grants to the said Buyer the exclusive and irrevocable option to purchase, under the conditions hereinafter provided, the following-described property, situated in MACON County, State of NORTH CAROLINA

(Insert here full and complete legal description of the property, including any water rights and water stock being purchased)

Beginning at the point of intersection of the East RW line of Sealy Road and Riley Stream runs thence S 70°-30' E for 200 feet, runs thence N 30°-15' E for 160 feet, runs thence S 70°-30' E for 200 feet, runs thence N 30°-15' E for 160 feet to point of beginning.

All water rights to the said property are included within this transaction are now the property of the buyer J.B. Smith, further this agreement has the following exception:

Termination of the lease may be administered by the buyer J.B. Smith if a flowing (greater than ten (10) gallons of water per minute) well is not found on the property on the first drilling of not greater than one hundred (100) feet below the existing surface of the land, further that the well must be of quality water as determined by the County Health Department. Such termination shall be final and include full reimbursement of the sum of $100.00 to the buyer J.B. Smith.

(over)

FHA 440-34 (Rev. 9-14-70)

Site Tests

suitability for septic tanks

The suitability for septic tanks is measured in terms of the soil percolation rate. The percolation rate is the rate at which water dissipates into the soil. The percolation rate has a direct relationship to the proper functioning of septic tank drainage fields. This test is the principal factor for determining the area of the drainage field. The suggested procedure for making percolation tests follows:

1. **Number and location of tests:** Six or more tests should be made in separate test holes spaced uniformly over the proposed absorption field site.

2. **Type of test hold:** Dig or bore a hole with horizontal dimensions of from 4 to 12 inches and vertical sides, to the depth of the proposed absorption trench. Post hole diggers are satisfactory for digging holes.

3. **Preparation of test hole:** Carefully scratch the bottom and sides of the hole with a knife blade or sharp pointed instrument to remove any smeared soil surfaces and to provide a natural surface soil into which water may percolate. Remove all loose material from the hole. Add 2 inches of coarse sand or fine gravel to protect the bottom from scouring and sediment.

4. **Saturation and swelling of the soil:** Carefully fill the hole with clear water to a minimum depth of 12 inches over the gravel. By refilling if necessary, keep water in the hole for at least 4 hours and preferably overnight. Allow the soil to swell overnight. This saturation procedure insures that the soil is given the opportunity to swell and approach the condition that it will be in during the wettest season of the year. Thus the test will give comparable results in the same soil whether made in a dry or a wet season.

In sandy soils containing little or no clay the swelling procedure is not essential and the test may be made as described under item 5(c) below, after the water from one filling of the hole has completely seeped away.

5. **Percolation rate measurement:** With the exception of sandy soils percolation rate measurements shall be made on the day following the procedure described under item 4 above:

a. If water remains in the test hole after the overnight swelling period, adjust the depth to approximately 6 inches over the gravel. From a fixed reference point measure the drop in water level over a 30-minute period. This drop is used to calculate the percolation rate.

b. If no water remains in the hole after the overnight swelling period, add clear water to bring the depth of water in the hole to approximately 6 inches over the gravel. From a fixed reference point measure the drop in water level at approximately 30-minute intervals for 4 hours, refilling 6 inches over the gravel as necessary. The drop that occurs during the final 30-minute period is used to calculate the percolation rate. The drops during prior periods provide information for possible modification of the procedure to suit local circumstances.

c. In sandy soils (or other soils in which the first 6 inches of water seeps away in less than 30 minutes, after the overnight swelling period) the time interval between measurements shall be taken as 10 minutes and the test run for one hour. The drop that occurs during the final 10 minutes is used to calculate the percolation rate.

6. **Additional criteria for judging soil suitability:** In areas of shallow ground water, the depth to the water table shall be determined. If for any extended period during the year the water table is normally at a depth of less than 4 feet, the results of the percolation test should be applied with caution. The case also warrants special consideration if impermeable layers are found at depth less than 4 feet.

DATA FOR DETERMINING NITRIFICATION FIELD REQUIREMENTS FROM PERCOLATION TEST

Average time required for water to fall one inch (in minutes)	Effective Absorption Area (area in bottom of nitrification trench) in square feet per bedroom**
2 or less	50*
3	60*
4	70*
5	80*
10	100*
15	120*
30	180
60	240

**Effective absorption area should be increased by 50% whenever automatic sequence washing machines are used.

*A minimum of 150 square feet of effective absorption area shall be provided per living unit.

MINIMUM CAPACITIES FOR SEPTIC TANKS

Number of Bedrooms	Minimum Liquid Capacity of Tank in Gallons*
2 or less	500
3	600
4	750
5	900
6	1100

*Increase minimum liquid capacity by 50% when household garbage grinder discharges into system.

The size of the septic tank is determined from the number of bedrooms in the home.

Using the percolation rate the drainage field site is determined as follows:

Example

Mr. Smith's percolation rate is one inch drop per four minutes. Mr. Smith is planning to have three bedrooms and a washing machine. From the chart on the left, Mr. Smith needs 70 square feet of septic field per bedroom.

70 sq. ft. (3 bedrooms) = 210 sq. ft.

120 sq. ft. + 50% = 315 sq. ft.

The total size of Mr. Smith's septic field should be 315 square feet.

Example

Mr. Smith plans to have three bedrooms and no garbage disposal. Therefore, he needs, according to the chart at left, a 600-gallon septic tank.

suitability for foundations

Ideal foundation-bed soil will support the weight of the proposed building, will not shrink or swell excessively, and will not heave from frost action. But such soil is rare. Dry, well-compacted, sandy clay soil probably comes closest to the ideal soil.

Before building on dry clay, make certain that it will not swell excessively when wet. Some clays swell enough to lift buildings. Sometimes foundation walls on such soil move horizontally even several inches. Some clays become plastic when wet and, when under moderate pressure, squeeze from beneath the foundation.

Frost heaving can be reduced if the foundation bed is below the frostline and adequate drainage is provided.

Inspect and inquire to determine if the site is filled. Filled ground generally causes trouble because of the variation in fill depth and because the different type of materials used for fill cause the filled ground to settle unevenly.

Spongy, or peaty, soils are found in the flat coastal plains area or in other poorly drained soil. Special engineering designs are needed for buildings and foundations on peaty soil. Building on these soils should be avoided if possible.

The site should be inspected for thin rock layers near the surface. In piedmont or mountain areas a relatively thin layer of rock occasionally overlies soft clay or loose sand. Such a site might be unsafe for heavy pier loads.

Soils differ in bearing capacity, and no soil behaves the same under all circumstances or has the same character at different depth below the surface.

The soil has to be investigated to determine its characteristics. The best time to do this is during a wet period.

Preliminary probes with a ½ inch or ⅝ inch rod about 12 feet long should be made. By driving the rod through soil, the type, depth and direction of the slope of the underlying strata can be determined. Also buried boulders or rock layers can be discovered.

If preliminary probing indicates questionable conditions, further investigation is needed. If so, the earth should be removed to the depth of the proposed footing and then, by using a soil auger, a hole should be drilled three feet below that point, so that the various strata can be noted.

A soil scientist, if needed, can be requested through the local Soil Conservation Service office to assist with the testing of sites for foundation suitability when the local district soil conservationist or county agricultural extension agent finds his services are needed.

slope suitability

The land slope is the change in elevation of the land relative to the horizontal distance. This is to say that, as one walks 10 feet horizontally and while doing so rises 2 feet vertically, he has moved up on a slope of 20 percent. The following slope ranges have been established for the three priority groups:

MOUNTAINS REGION

Priority Group I — 0 to 8 percent
Priority Group II — 8 to 25 percent
Priority Group III — Over 25 percent

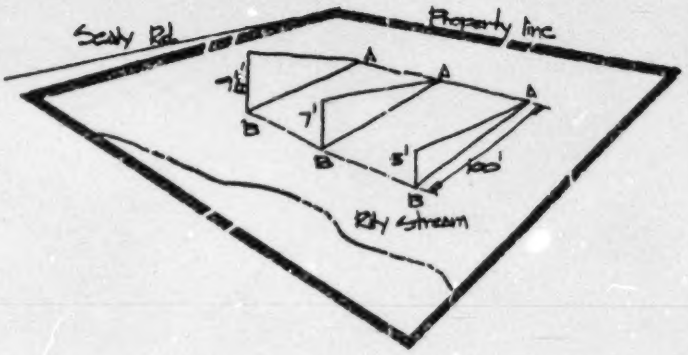
PIEDMONT REGION

Priority Group I — 0 to 8 percent
Priority Group II — 8 to 15 percent
Priority Group III — Over 15 percent

COASTAL PLAINS REGION

Priority Group I — ½ to 8 percent
Priority Group II — Over 8 percent
Priority Group III — Less than ½ percent

The slope data that was used for the initial screening in Section I was from the Soil Survey. This data is not accurate enough to yield the slope for any given site. Therefore, an average slope of the site must be determined on the site to make certain that the site is within the proper priority group in regard to the land slope. Slopes of less than 15 percent usually do not create serious problems for a building site provided the soils are otherwise satisfactory.



Determining the Slope

1. Locate the direction of the land slopes.

2. Locate three areas across the site that are representative of the average slopes on the site.

3. In each of the three areas, choose a point A on the uphill portion of the area and, second, choose a point B in each of the three areas that is 100 feet downhill from A.

4. Secure one end of a string level with the base of a stake at a point A and bring the line to a level with the opposite end of the string attached to a vertical calibrated rod at point B. Determine the elevation difference between the two points for each of the three areas on the site.

$$\% \text{ SLOPE} = \frac{\text{VERTICAL DIFFERENCE}}{\text{100 feet}} \frac{100}{1}$$

Example

To determine the average slope on Mr. Smith's priority site, three readings were taken as are described above. The vertical differences between point A and point B for the three areas was 7 feet, 9½ feet and 5 feet.

Thus Mr. Smith's site had slopes of 7 percent, 9½ percent and 5 percent. The average slope (taken by adding the three slopes and dividing by three) was 7.17 percent, which is within the priority Group I range (Mountain Region).

erosion management suitability

The erosion management suitability of the site is related to the soil type, length of slope, steepness of slope, rainfall factors, wind factors and vegetative cover. Information on the erosion problems on the site as well as their solution may be obtained from the county Agricultural Extension Service or the local Soil Conservation Service district office.

For additional assistance use: *Guide for Sediment Control on Construction Sites in North Carolina*, U.S. Department of Agriculture, Soil Conservation Service, 1973. Available at Raleigh office.

depth to bedrock

For sites in the mountain and piedmont regions tests should be made to determine the depth to bedrock.

The depth to bedrock should be determined in the site tests. This information can be obtained relatively easy and quick on the site. The depth of bedrock will not only determine the drainage characteristics for the septic field but also the ease with which the foundations and underground utilities can be constructed.

To perform the test, five or six drillings will need to be made on an acre site. This test can be completed in conjunction with the percolation tests and thus use the same equipment. The drillings should be made with a 4- to 6-inch diameter auger and bored to a depth of 7 feet, or less if bedrock is struck. The depth of each drilling should be recorded on a site map. Any area of the site which has bedrock less than 3 feet below the surface will be unsatisfactory for foundations and underground utilities. In the area of the septic field and tank the bedrock must be at least 7 feet deep. This data *must* be gathered for any site which has exposed rock outcroppings, and should be completed for all others.

Example

Mr. Smith's Site A was found to be unsatisfactory for test 5, Depth to Bedrock. The average depth of the bedrock was approximated 4 feet. However, Site B was found to be satisfactory.

no potential flooding

No homesite should be selected in an area which is subject to flooding. The preliminary mapping in Section I utilized the Soil Survey data for determining flooding susceptibility. A more accurate indication of the flooding potential is needed. The Tennessee Valley Authority, the U.S. Geological Survey and the Soil Conservation Service have mapped flooding elevations. The TVA has maps for a few of the "mountain counties." These TVA maps are quite accurate and complete for those counties. If a site is being tested which could be subject to flooding, then the flood elevation maps *must* be checked.

If the site is within an area that is not shown on the flooding elevation maps and the site could be subject to flooding, (example, a small tributary), then the Soil Conservation Service area engineer should visit the site for a field survey.

ground-water level suitability

In some soils the ground-water level is a foot or a few feet below the surface year round! In other soils the ground-water level is high only in winter and early in the spring. In still others the water level is high during periods of prolonged rainfall. A sewage-absorption field will not function properly under any of these condition.

Soil surveys usually include information about soil drainage and ground-water levels, especially those surveys of areas where the ground-water level is near the surface most of the time. Some surveys give the depth, in feet or inches, to the seasonally high water tables. Others point out that a soil is well drained, poorly drained, or very poorly drained. Well-drained soils are suitable for use as septic-tank absorption fields; poorly drained soils are not. Poorly drained soils are usually dark in color, and well-drained soils are light in color.

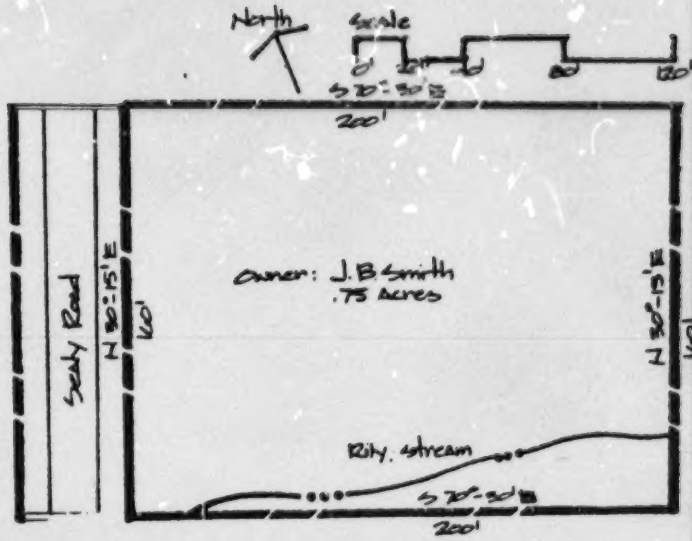
A hole dug in soils with a high ground-water level will quickly reveal the depth to the ground-water level as the water will rise and stand in the hole at the ground-water level.

The ground-water level, during the wettest season, should be at least 4 feet below the bottom of the trenches in a subsurface-tile absorption field.

site development

property survey

Each site should be surveyed by a registered surveyor and a map drawn and registered with the deed of the property after a title search. This will provide the necessary legal protection for the homeowner and the housing professional in order to proceed with the development. The surveyor should mark the boundaries of the property for the concerned parties. If the county has accurate property ownership maps, the surveyor should compare his survey with that of the county map. If any disagreement is noted, the dispute should be settled at this time.



Topographic Map

While the surveyor is on the site he should lay out a grid (preferably a 10-foot grid on acre sites) and make transit readings for a topographic map. The surveyor should prepare a map with 1 foot contours at a 1 inch = 20 feet scale, indicating high and low point spot elevations, and spot elevations at any sudden changes in elevation, as well as locating the direction of north, existing structures, fences, pipes, ponds, drains, drainage ways, streams, rock outcroppings, power or telephone lines and poles, easements, right of ways, trees, etc. The surveyor should keep the original map on file in his office and prepare three or four blueprints for your use in the following steps.

DEED

SAMUEL JONES, Trustee for

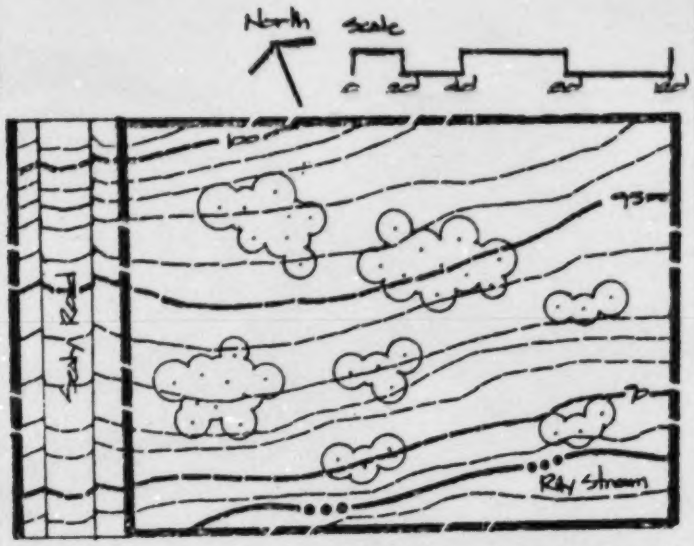
Revolving Loan Fund, et ux

J. B. SMITH and wife,

SUSAN R. SMITH

Example:

The property survey, deed and topographic survey have been completed for Mr. Smith's site. The examples (right) show a reduction of each of the three:



The topographic survey can be completed by someone other than a registered surveyor; however, the person must be experienced in surveying. Additional information and assistance can be obtained from the Agricultural Extension Service for possible assistance in training of a paraprofessional for topographic surveying and site testing.

locating the well

In locating the well, keep in mind that it must be located in accordance with North Carolina "Well-Construction Regulations and Standards." The well must be at least 10 feet from any property line, and the septic field must later be located at least 100 feet from the well. Avoid locating the well in an area subject to frequent flooding. In addition to these restrictions, certain counties now require that the well site eventually chosen must have the final approval of the local health department.

With the use of a topographic map, select a location for the well after carefully considering both the above requirements and those factors governing ground water yield which are summarized below.

Topography influences yield by its effect on the infiltration of rainfall and by its effect on ground water flow towards or away from the well site. Some of the rain falling on hills and slopes runs off as overland flow and ultimately percolates to the ground water zones beneath the valleys. Therefore, while hills and slopes are deprived of this water, valleys actually benefit from it. Water movement beneath hills and slopes is also towards the valleys. Due to these natural conditions, wells drilled in valleys or on the lower sides of slopes have larger recharge area from which to draw water than do wells drilled on hills or ridges. The topographic locations in order of decreasing yield are: draw, valley, slope, flat, and hill.

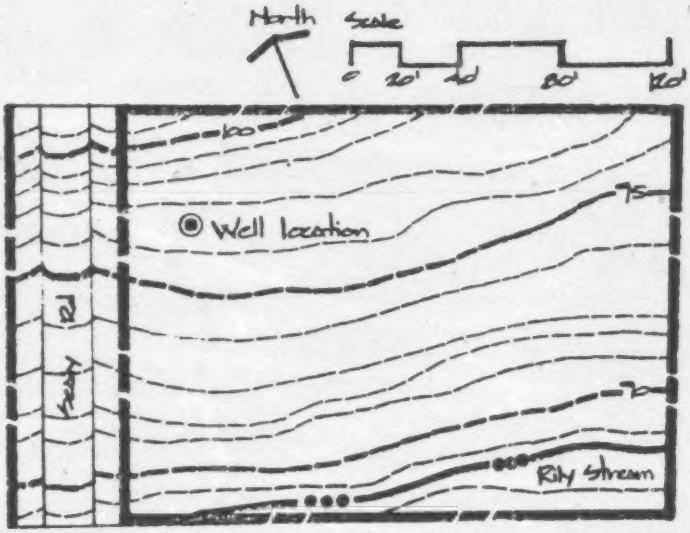
In the mountain and piedmont regions, topography also serves to reflect to some degree the permeability of the bedrock. The less fractured rocks resist weathering to form hills and ridges, whereas the more highly fractured rocks, which constitute good aquifers, are usually expressed as valleys and draws. Therefore, wells drilled in these areas are more likely to intersect a greater number of water-bearing fractures than are wells drilled on hills and ridges. In addition to topography, a thick mantle of weathered materials overlying the parent rock is also a good indication of jointed or fractured bedrock below. A thick mantle, though not necessarily highly permeable, may also serve as an excellent reservoir from which water may enter the fractures.

H. E. LeGrand developed a point value method for evaluating well sites in the mountain and piedmont regions. The method, which is based on topographic features and saprolite thickness, is explained in USGS Circular 538 and is available on request from the Director, United States Geological Survey in Washington, D. C. It is recommended to those desiring a quantitative method for use in the mountains and piedmont.

In the coastal plain region, ground water availability is generally not a serious problem. Because an adequate supply of water is generally available throughout the coastal plain, emphasis should be placed on health considerations when locating the well. This is particularly important as contamination of the water supply can occur more easily in the coastal plain than in other areas of the state.

Once a site has been selected, the well should be drilled until zones sufficient to yield water in adequate quantities have been penetrated. Upon the completion of satisfactory drilling, the well must be properly sealed and the water tested by the County Health Department.

If water has not been obtained in sufficient quantity, or quality, other sources should be investigated. Alternatives might include: (1) drilling another well on the site, but in a different location that might prove more suitable for a well or, (2) drilling another well on a nearby site. If there are no satisfactory alternatives, one should consider abandoning the site for another location (return to Section I, Step 5 or 6).



Disadvantages of Certain Type Wells

Often the quantity and quality of ground water is directly related to the type of well constructed. Therefore, the State Ground Water Division recommends that home owners avoid small diameter wells (less than 3 inches) and large diameter wells cased with concrete pipe ("bored" wells). Disadvantages associated with small diameter wells include difficult maintenance, thin casing, restricted yields, and difficult screen installation. "Bored" wells are difficult to protect from contamination, frequently go dry during periods of drought, and are difficult to abandon properly. Many bored wells also prove too shallow to provide an adequate water supply for domestic purposes.

Example

Mr. Smith's well has been located, drilled, and properly developed on the site. The well was located (example left) with due regard to existing state and county regulations, and after careful consideration of the immediate topography. A satisfactory yield of water was obtained. A water sample was taken by the County Health Department, after which the well was sealed. The test results indicate a quality water source.

Consultative Services

Should questions arise or problems develop, assistance may be obtained from the State Ground Water Division. Requests should be addressed to the nearest division field office. For convenience, the offices are listed below:

Raleigh Office
P. O. Box 27687
Raleigh, NC 27611
919-829-4740

Wilmington Office
3401 Wilshire Blvd.
Wilmington, NC 28401
919-762-6380

Asheville Office
159 Woodfin St.
Asheville, NC 28801
704-253-3341

Washington Office
P. O. Box 1082
Washington, NC 27889
919-946-6481

Lumberton Office
P. O. Box 294
Lumberton, NC 28358
919-739-4628

Ahoskie Office
P. O. Box 68
Ahoskie, NC 27910
919-332-2864

Mooresville Office
P. O. Box 1306
Mooresville, NC 28115
704-664-4627

slope analysis

A slope analysis should be made for sites with slopes typical of the piedmont or mountain regions. Such a procedure may not be needed for the typical site in the coastal region, but there are sites for which this would be needed. All sites have some slope.

A slope analysis is a visual presentation of the slopes of a portion of land. The potential slopes that may be found on the site can be divided into five categories: 0% to 4%, 4% to 8%, 8% to 12%, 12% to 20%, and greater than 20%. The percent slope is determined with the following equation:

$$\% \text{ Slope} = \frac{\text{Vertical distance}}{\text{Horizontal distance}} \quad \frac{100}{1}$$

Slope Between Adjacent Contours

The horizontal distance between two adjacent contours should be measured on the topographic map (1 inch = 20 feet). The vertical distance between two adjacent contours is one, if the contour interval is 1 foot. As contour lines become closer together on the map, the slope is increasing. The direction of the slope is determined by reading the contour line elevations.

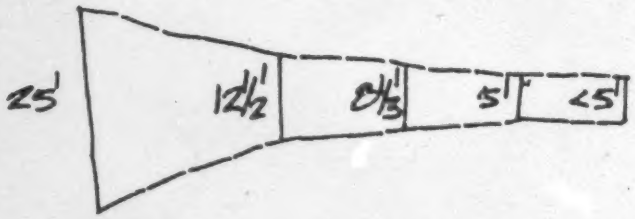
With a contour interval of one foot and a 1 inch = 20 feet scale map, then:

Distance Between Adjacent Contours	Percent Slope
Over 25 feet	Less than 4%
25 feet	4%
12½ feet	8%
8⅓ feet	12%
5 feet	20%
Less than 5 feet	More than 20%

Determining the Slope Analysis

1. Measure distances between adjacent contours on th 1 inch = 20 feet scale topographic map of one-foot contours

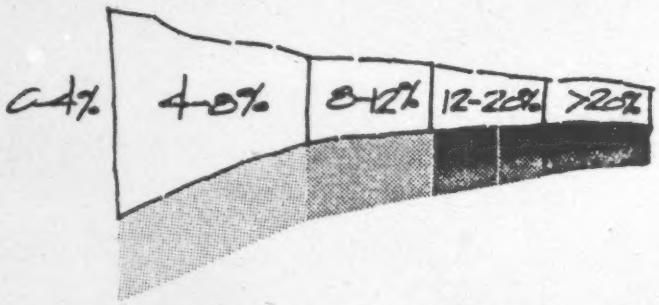
2. Indicate all locations on the topographic map wher adjacent contours are either 5 feet, 8⅓ feet, 12½ feet, o 25 feet apart.



3. Determine the area slope range of all the areas between adjacent contours, that is, color code the slope ranges on the map.

Slope Range	Distance Between Countours* Step 2 Above
0% to 4%	Over 25 feet
4% to 8%	Between 12½ feet & 25 feet
8% to 12%	Between 8⅓ ft. & 12½ ft.
12% to 20%	Between 5 feet & 8⅓ feet
20% and up	Less than 5 feet

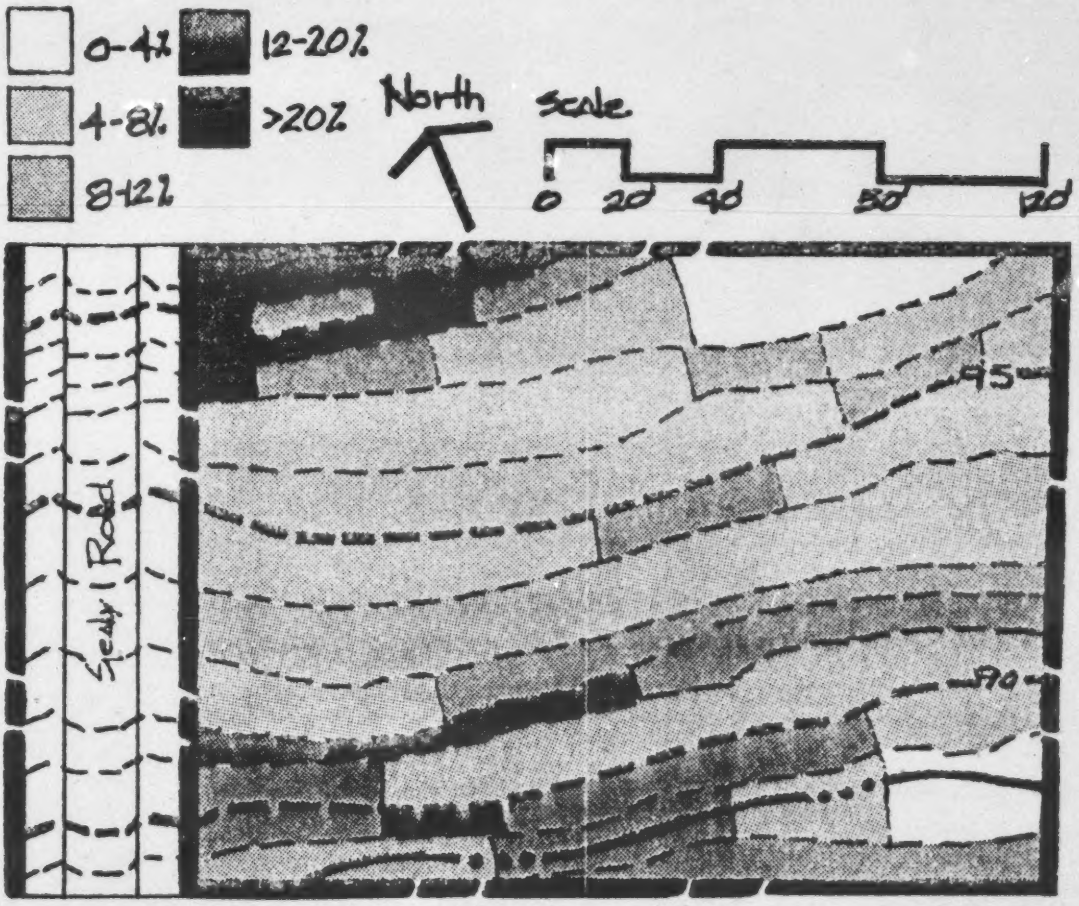
* Slope range corresponds to an area within the two adjacent contours and between two adjacent distance indications of Step 2.



4. Continue determining the slope range areas between all the contours on the property. Code all areas on th topographic map to one of the five slope ranges.

Example

The example below shows a completed slope analysis of Mr. Smith's property. The slope ranges of the slope analysis provide a fast and easy way to locate the drive, buildings, walks, etc. Since each of the facilities to locate should ideally be located within one of two of the ranges, the slope analysis becomes a key for developing a site plan.



locating the driveway on the site

In locating the driveway and other facilities on the site, the slope analysis should be utilized. Alternative locations can be sketched on tracing paper laid over the topographic map with the site analysis. The property owner should assist in making the decisions in the following steps.

Before the facilities are located on the map, areas of existing trees that are desirable to save should be located. To save a maximum number of the trees on the site one should locate the major facilities nearby, but not within the trees. Trees within areas of 0-4% slopes can be closer to the major facilities (example, driveway, house, patio) than trees within areas of greater slope, since less cutting and filling of the soil will be required on 0-4% slopes, and thus less damage will be done to the trees.

To save trees the soil under the branches of deciduous trees and the soil within the distance equal to the ½ height of pine trees should *not* be cut or filled upon. Any soil elevation or disturbance under the trees, even a change of 2 inches, may damage the trees. If cutting or filling must be done near trees that are to be saved, the Agricultural Extension Service's information on constructing retaining walls and wells for trees should be of value. (See *Landscaping Your Living Space*, N.C. Agricultural Extension Service Circular No. 534.)

Driveway Location

Although the slope of the driveway is not typically a problem in the coastal plains region, it should be considered in other regions of the state.

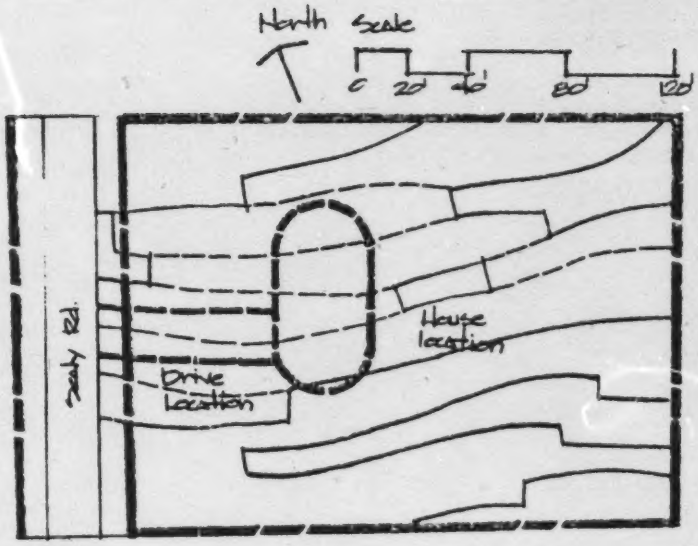
The maximum slope of a driveway should be 8 percent. The driveway should ideally be located from an access point onto the site *across the land with the least slope* to the general house location. Thus, the driveway should be located within the slope ranges 0% to 4% and 4% to 8%. By locating the driveway in this area, less cutting and filling of soil will be required during construction and thus less potential for soil erosion.

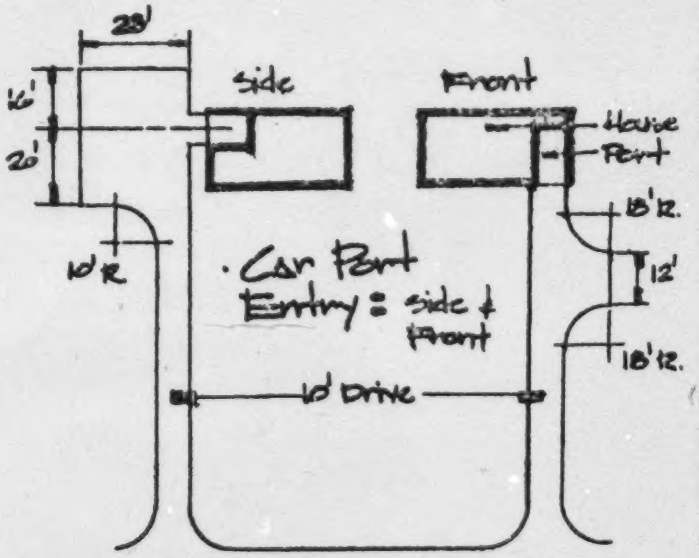
The procedure for locating the driveway is to:

1. Locate the possible points of access onto the site.
2. Locate the land that has slopes under 8 percent.
3. Locate the best position for the driveway (10 to 12 feet wide) to the side. It is desirable to locate the drive parallel to the contour lines where possible.
4. Locate an end to the driveway near the possible location of the house.
5. Locate a turn-around area near the end of the drive (note the examples).

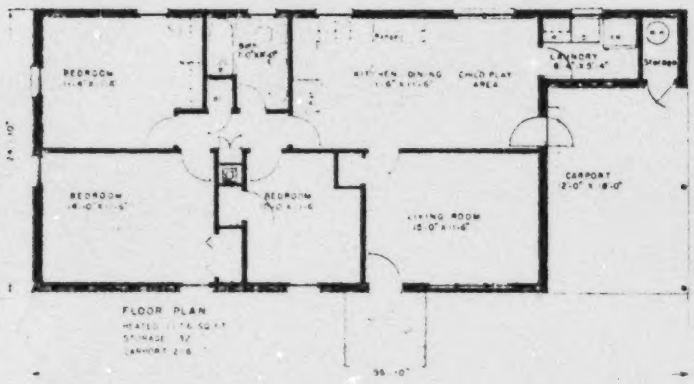
NOTE: On steep sites the slope percentages for the driveway location can be adjusted up.

Example: The drive and turn-around area have been located on Mr. Smith's property. The map below shows the position of the drive in reference to an access point, the 0% to 8% slopes and the general house location.





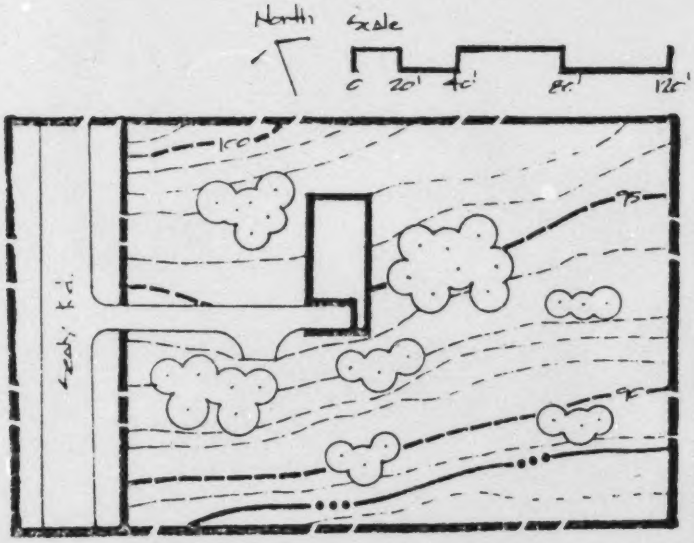
locating the house



Before the house can be located on the site, a design of the house must be completed to know the layout of the house and its entrance points. If one can afford the service, an architect would be the best person to develop the plan for the house. The Agricultural Extension Service offices have free standard house plans for North Carolina families, with plan books in all county offices.

The house should be located on as nearly level land as possible and elevated somewhat for drainage around the house. No surface drainage should run toward the house location. The house should generally be set back from the property lines by a minimum of 20 feet on the side yards, 40 feet on the rear yard and 30 feet on the front yard. The building should be located adjacent to the driveway.

The house should be positioned to take advantage of the best views and provide for climatic protection. The drive location may need to be adjusted for the best house location and position.



Example:

Mr. Smith located his house on the property in relationship to two criteria:
(1) choosing a location near the driveway and (2) choosing a location on slopes of 8%. The position of the house was chosen for: (1) the best views of the site and neighboring areas, (2) the easiest position for garage access and (3) the best position in relation to the direction of the winter winds, the prevailing winds and the summer sun.

The following example (left) shows the selected location and position on the site.

locating activity areas

Determination should be made, with the help of the family, of the types and location of activity areas that are needed. Private, public and service areas should be located on the site.

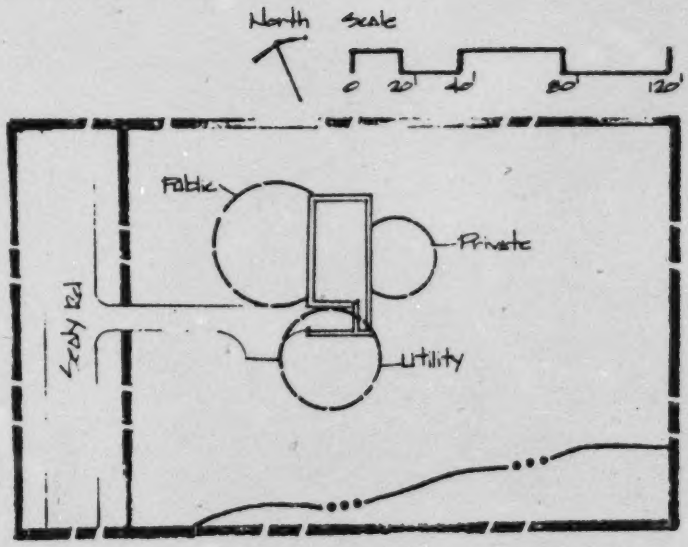
1. Public area—is the area that is open to view from the road and where people would enter the property. The front yard is usually considered as a public area.

2. Private area—is an area set aside for outdoor living. This area should be in a private or semi-private area of the property. The area is usually adjacent to the family room of the house.

3. Service area—is an outdoor extension of the garage and kitchen area. Storage buildings, garbage collection, etc., are usually placed in this area. If the family has or plans to have children, some large play areas may need to be set aside. By locating these areas they can be kept open for development in keeping with the desired activities. The activity areas should be located on slopes under 8 percent if possible (use the slope analysis map). In flat land areas such as are typical in the coastal region, consideration should be given to adequate surface drainage.

Example:

The activity area locations for Mr. Smith's property have been determined (example right). The private area was chosen with considering the location of the existing trees, so as to provide for a more enclosed shaded area. A play area has been set aside for Mr. Smith's children. Care was taken to keep the play area on slopes less than 8 percent but adjacent to steeper slopes for less active types of play.



locating other site facilities

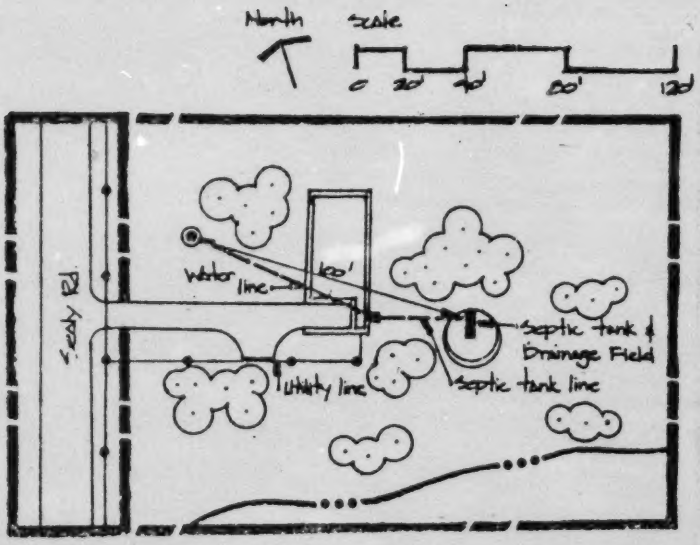
Septic-Tank Absorption Field

The septic-tank absorption field should be located downhill and at least 100 feet from the well. The locations of the septic-tank absorption field, the well and house should be considered simultaneously. The field and its location in relation to the well must be approved by county sanitarians in North Carolina.

In Section II of the manual the necessary size of the field was determined. The county health department has specifications for the construction of fields. The area of the septic-tank absorption field may double for some other activity. A large play area may cover some of the same area where the field is to be located.

The area should be planted in grass and kept well cut. It is not generally recommended that the area be cultivated for fear of disturbing drain tile.

The septic tank should not be located closer than 5 feet to the house foundation wall.



Location of Utilities

If there are any overhead utilities on the site, they should be located outside of the activity areas with the exception of the service area. Underground utilities should be placed in areas where building or earth movement might not occur in the future. To prevent storm damage to the utilities, all should be placed underground where possible.

Propane tanks should be located away from the house and near the driveway providing for sufficient space for truck access to the tank.

Example

The location of the septic-tank absorption field, the septic tank and utilities for Mr. Smith's property is shown (left). Mr. Smith needs 315 square feet of septic field and a 600-gallon tank (determined in Section II).

Patio or Deck Location

If the new homeowner prefers to cook or entertain outside, then a patio or deck should be considered. The cost of decks usually prohibits their use for a low-income house; however, a patio can be constructed on grade less expensively.

A solid patio or deck should have a slope of ¼ inch per foot or about ½ percent slope across the surface to provide for water movement off the surface. Slope the patio away from the house.

Wooden decks that have gaps between the boards do not require any slope to the surface and can be constructed on level. Decks are often located over a steep slope overlooking a stream, lake or valley.

Walk Location

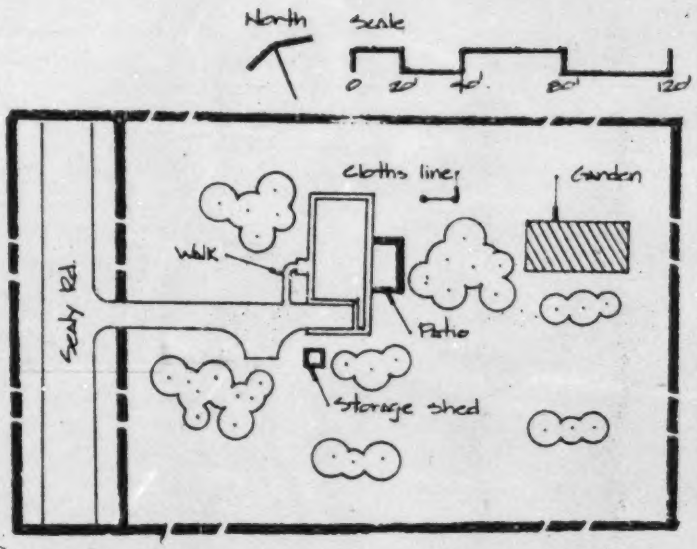
Walks should be located along anticipated pedestrian paths that would be used frequently. Walks on relatively level sites usually do not pose a slope problem. On more sloping sites, walks should be located, where possible, parallel to contour lines and on areas of the site that have less than 4 percent slopes. The pedestrian walks should be constructed from 36 inches to 42 inches wide and with a maximum slope of 7 percent. At steep slope changes steps should be utilized. The cross slope for a walk should be ¼ inch to ½ inch per foot.

Example:

Following is a list of Mr. Smith's desired facilities:

1. Patio
2. Walks
3. Clothes line
4. Garden
5. Storage area

The example (right) shows all the facilities located on the topographic map of Mr. Smith's property.



Other Facilities

All facilities such as a clothesline, shop, tool shed, garden, livestock area, etc., should be located in the plan and shown on the map. A shop or tool shed should be located in the service area, while a clothesline would probably be located between the private and service areas and near the kitchen or laundry room area of the house. The garden should be located in an open flat area which has a good friable fertile topsoil.

grading the site

Most sites require some grading, but slightly sloping sites usually require little or maybe none. The finish grade on all sites should be such that surface water drains away from the house. For sites in the mountain or piedmont area, grading is generally necessary.

Once the area to be graded has been located on the site, the topsoil should be stripped. The soil should be stock-piled in an area on the site that will be away from construction, trees and any protected area.

Next, the area should be graded to 4 inches below the proposed grade that has been determined. This grading need not be completely accurate at this time, but it should allow for water movement off the site during construction. Erosion control measures must be taken to prevent erosion once the soil on the site has been broken. Several small check dams can be built on the site to prevent increased stream sedimentation.

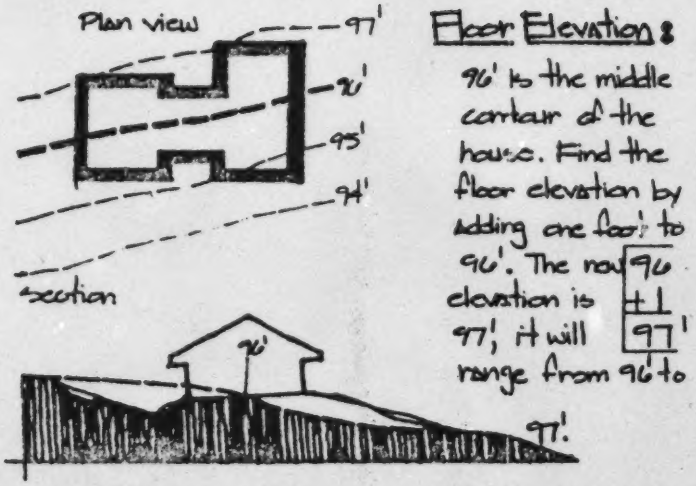
The house construction can now proceed. All trees that are especially close to the building location should be protected with a wooden guard. During construction, all scraps, masonry, chemicals, etc., should be kept collected in a small area rather than over the whole area.

Any retaining walls, tree wells, etc., should be constructed before erosion takes place. Because of soil compaction on the site during construction, trees within the construction area may require additional water. After construction all debris should be removed from the site. To bury it on the site usually causes a problem later.

Developing the Grading Plan

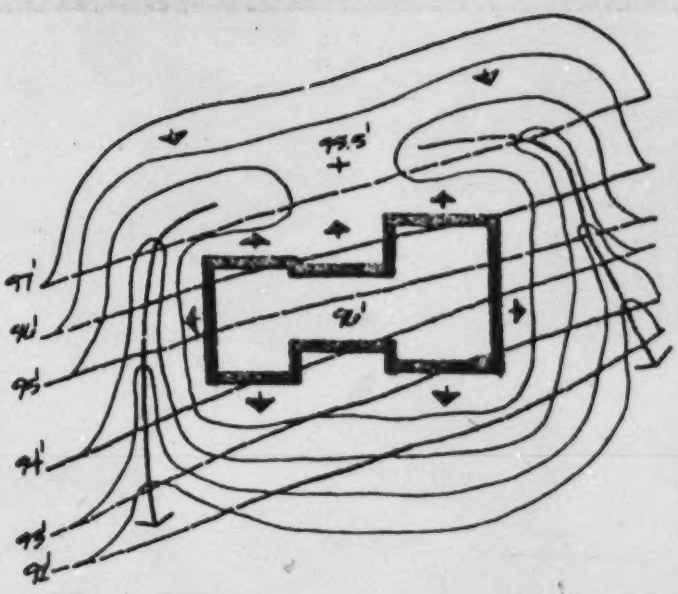
To develop a complete and accurate grading plan and/or site plan, a landscape architect should be consulted. However, the following steps will provide a few fundamental considerations. They should provide sufficient information to determine a general scheme and should provide a general standard to assess for proper drainage on the site after the earth work has been completed.

1. Determine the first floor elevation of the house.

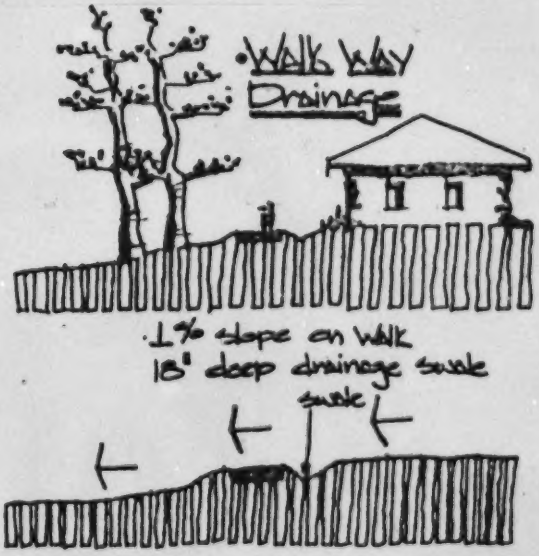


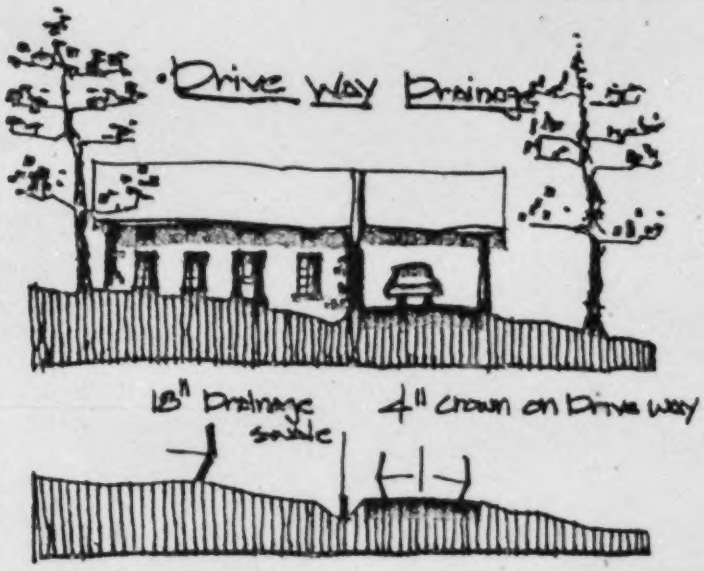
Generally, it should range from equal to, to 1 foot above the elevation of the contour running midway through the location of the house.

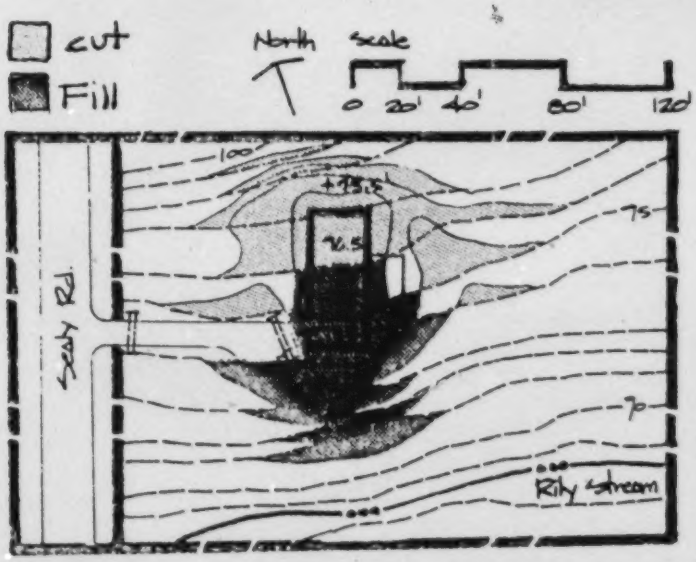
2. The soil should slope 10 feet, if possible, away from the house in all directions with a maximum slope of 10 percent and a minimum slope of 2 percent.



3. Swales should be used to collect water and move it around the side of the house. The highest point of the swale should be at least *one foot below* the floor elevation. In the example the highest point is shown with the spot of 94.5 which is 1.5 feet below the floor elevation of 96.0. The swale should have a side slope of 1 to 3 percent and a length slope of 3 to 5 percent.







4. Water should be collected along the side of a walk or a drive and not be allowed to run across the surface. The surfaces should be sloped to one side or both (example, crowned drive). Low points of the swales along the drive may require culverts for drainage under the drive. A 6-inch culvert or pipe will usually suffice for drainage under walks.

5. Paved surfaces such as a patio, parking area, etc., require the interception of water before it crosses the surface and the collection of water that falls on the surface. The interception of water should be handled similarly to the walk or drive example. The paved surface should have a 1 to 2 percent cross-slope.

6. The necessary grading should be determined. The new grades should return to the existing grades as quickly as possible but within desirable slopes. No larger part of an area should be graded than necessary. Within the area to be graded, determine which are the areas of fill and which are the areas of cut (note the example).

post construction planning

Post-construction planning is needed on all sites. For sites where grading is also needed, the homeowner should follow certain steps in returning the topsoil to the area for seeding. (Following construction the soil around the building will be compacted.)

1. Thoroughly disc the soil and then grade to 4 inches below the proposed grades.

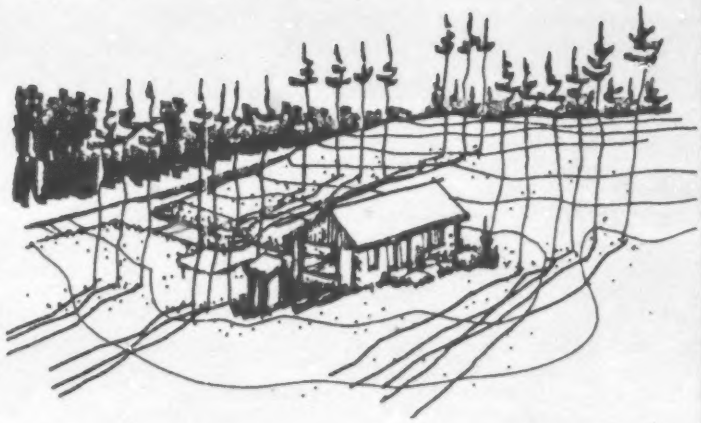
2. If desirable, spread a 4-inch layer of topsoil from the stockpile over the graded area. (If no topsoil existed on the site, you may wish to haul some to the site.)

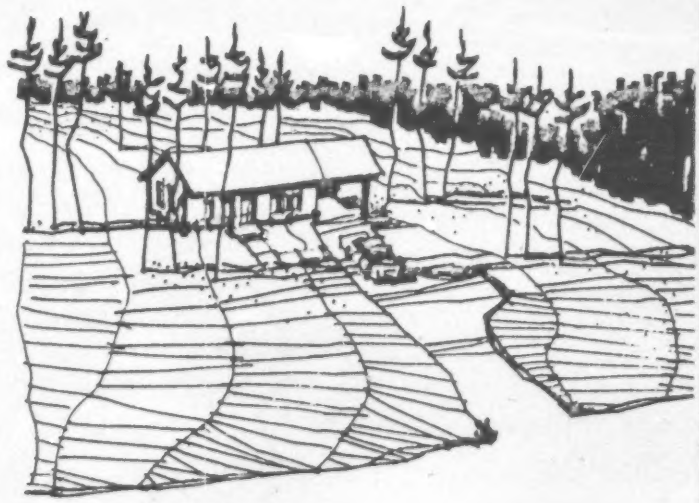
3. Harrow and/or rake the soil to a very smooth surface.

4. Seed a ground cover over the site.

Sloping areas, especially swales, can easily erode prior to grass coverage, so necessary steps should be taken to stake burlap over these areas. This will help to prevent sedimentation of streams.

The new homeowner may wish to plant trees and shrubs on the site. Usually he wastes money if he does not select plants for the purpose needed. The ultimate size and species of the plants should be closely evaluated.





appendix

North Carolina Laws Relating to Site Development

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Ground Absorption Sewage Disposal Disposal Act of 1973. House Bill No. 296

The Ground Absorption Sewage Disposal System Act became effective October 1, 1973. The following is a brief summary as supplied by the State Board of Health:

"The act applies in areas not served by public or community sewerage systems. Requires an improvements permit (sewage disposal permit) prior to construction of a residence and a certificate of completion (approval of septic tank system installation) before a conventional residence or mobile home can be occupied. For conventional construction, an improvements permit must be obtained before other permits (plumbing, electrical, etc) can be issued. For mobile homes, a certificate of completion must be obtained before other permits can be issued. Electrical service cannot be provided until the electrical inspector certifies that required improvements permit for conventional dwellings or certificate of completion for mobile homes has been issued. Mobile home dealers must post signs relating to the provisions of the Act, and distribute a summary, prepared by the State Board of Health, of the Act. Developers can be exempted who submit plans for community systems and certify that systems will be installed before permitting occupancy."

S 692 (H 950) - An Act to Amend Article 13, Chapter 130, North Carolina General Statutes Relating to Water and Sewer Sanitation. Chapter 471, Session Laws of 1973

"**Provisions:** Act amends G.S. 130-160 and G.S. 130-161. Provides that a sewage disposal system with design capacity of 1500 gallons or less, and serving a single or two-family residence, place of business or place of public assembly shall be approved under regulations of State Board of Health. All other such systems of more than 1500 gallons shall be approved under regulations of Board of Water and Air Resources. G.S. 130-161 is revised to deal, essentially, only with systems of water supply [exceptions listed in G.S. 130-161 (4) would be deleted]."

"The intent is to clearly define the sewage disposal responsibilities of the State Board of Health and the Office of Water and Air Resources. Also, we understand that the new Federal Water Pollution Control Act requires that State water pollution control agencies approved for issuing federal discharge permits must have control over all significant waste discharge."

North Carolina Well-Construction Act

The North Carolina Board of Water and Air Resources is required, under the provision of Chapter 87, Article 7, Section 87, General Statutes of North Carolina (Short Title: North Carolina Well Construction Act) to adopt appropriate rules and regulations governing the location, construction, repair, and abandonment of wells, and the installation and repair of pumps and pumping equipment.

In accordance with this requirement and pursuant to a public hearing in Raleigh, North Carolina on April 15, 1971, North Carolina Well Construction Regulations and Standards governing the location, repair and abandonment of wells, and the installation and repair of pumps and pumping equipment were adopted by the Board of Water and Air Resources the 26th day of August 1971, to be effective January 1, 1972.

A booklet titled "North Carolina Well Construction Regulations and Standards" is available from the Department of Water and Air Resources, Raleigh, N. C.

North Carolina Sedimentation Pollution Control Act of 1973. Effective date July 1, 1973.

Some excerpts from the Act are as follows:

"**113A-51. Preamble.**—The sedimentation of streams, lakes and other waters of this State constitutes a major pollution problem. Sedimentation occurs from the erosion or depositing of soil and other materials into the waters, principally from construction sites and road maintenance. The continued development of this State will result in an intensification of pollution through sedimentation unless timely and appropriate action is taken. Control of erosion and sedimentation is deemed vital to the public interest and necessary to the public health and welfare, and expenditures of funds for erosion and sedimentation control programs shall be deemed for a public purpose. It is the purpose of this Article to provide for the creation, administration, and enforcement of a program and for the adoption of minimal mandatory standards which will permit development of this State to continue with the least detrimental effects from pollution by sedimentation. (1973, c. 392, s.2.)"

"**113A-53. Sedimentation Control Commission.**—(a) There is hereby created in the Department of Natural and Economic Resources the North Carolina Sedimentation Control Commission, which is charged with the duty of developing and administering the sedimentation control program provided for in this Article. The Commission shall consist of the following members:

(1) The Secretary of the Department of Natural and Economic Resources, who shall be chairman, and who may designate some other officer in the Department to act in his stead;

(2) A person to be nominated by the board of the North Carolina Home Builders Association;

(3) A person to be nominated by the Carolinas Branch, Association General Contractors of America.

(4) The president, vice-president, or general counsel of a North Carolina public utility company;

(5) The Director of the North Carolina Water Resources Research Institute;

(6) A member of the State Mining Council who shall be a representative of nongovernmental conservation interests, as required by G.S. 74-38(b);

(7) A member of the State Soil and Water Conservation Committee;

(8) A member of the State Board of Water and Air Resources;

(9) A soil scientist from the faculty of North Carolina State University;

(10) Two persons who shall be representatives of nongovernmental conservation interests."

"113A-57. Mandatory standards for land-disturbing activity.—No land-disturbing activity subject to this Article shall be undertaken except in accordance with the following mandatory requirements:

(1) No land-disturbing activity shall be permitted in proximity to a lake or natural watercourse unless a buffer zone is provided along the margin of the watercourse of sufficient width to confine visible siltation within the twenty-five percent (25%) of the buffer zone nearer the land-disturbing activity, provided, that this subdivision (1) shall not apply to a land-disturbing activity in connection with the construction of facilities to be located on, over, or under a lake or natural watercourse.

(2) No slope may be graded to an angle greater than the angle of repose for saturated soil conditions applicable for the type of soil involved, unless the soil on such slope is retained by some adequate erosion controlling structure or device. In any event, soil left exposed will, within 30 working days of completion of any phase of grading, be planted or otherwise provided with a ground cover sufficient to restrain erosion.

(3) Whenever land-disturbing activity is undertaken on a tract comprising more than one acre, if more than one contiguous acre is uncovered, a ground cover sufficient to restrain erosion must be planted or otherwise provided within 30 working days on that portion of the tract upon which further active construction is not being undertaken, provided, that this subdivision (3) shall not apply to cleared land forming the basin of a reservoir later to be inundated. (1973,c.392,s.8.)"

Outline of Main Features of Revised Coastal Area Management Bill

A. Land Use Planning

(1) Defines "coastal area" as the counties bounded by the Ocean or a sound, or intersected by a sound to the limits of seawater encroachment.

(2) Each coastal area county and city may adopt a land use plan, consistent with objectives of Act.

(3) State prepares guidelines for local plans, and reviews (and finally approves) local plans.

(4) Counties may delegate planning (to LRO) to provide intermediate review of plans and guidelines.

(5) State or LRO will prepare the plan for any county failing to do so.

B. Land Use Management

(1) "Areas of environmental concern" (AEC's), to be designated by Coastal Resources Commission. These areas include beaches, sand dunes, coastal marshlands, estuarine waters, and other important natural features.

(2) A permit to be obtained for development within an AEC, to be coordinated with existing controls on cutting sand dunes, dredging or filling in estauries or coastal wetlands and other environmental permits.

(3) Local governments issue permits for minor developments; State issues permits for major projects. Enforcement of Act shared by State and localities.

C. State Organization

(1) A new 15-member Coastal Resources Commission appointed by the Governor, consisting of citizens interested and expert in coastal area conservation and development - to make regulations and policy. Local governments nominate 12.

(2) A new 47-member Coastal Resources Advisory Council, large enough to allow direct representation of the local governments in the area, the regional planning agencies, and six designated State departments.

(3) State-level planning to be supervised by State Department of Administration. State-level management to be supervised by State Department of Natural and Economic Resources (NER).

D. Timing

(1) First hearing on designating interim areas of environmental concern to be held withing 2-10 weeks after 7/1/74.

(2) Local land use plans to be adopted approximately 17 months after 7/1/74.

(3) New permit system to be installed no later than 27 months after ratification of Act. Pending installation of new permit system, developments must notify Commission of proposed projects within AEC's.

E. Financing

$200,000 was authorized in a separate bill, to be appropriated to Department of Admimistration and NER to carry out their responsibilities under the Act (with federal matching funds to be sought).

Sources of Information on Site Planning

County consultants will usually be able to supply information for client families in each county. Further inquiry when needed may be made to the sources given below.

CONTACT:	FOR ASSISTANCE WITH:
U.S. Army Corps of Engineers Wilmington, NC	Surface water and flooding.
Farm Credit Service Columbia, SC	House loans.
Farmers Home Administration Federal Building Raleigh, NC 27601	Housing and site loans.
U.S. Geological Survey Water Resources Division Federal Building Raleigh, NC 27601	Quality and quantity of surface and subsurface water.
Department of Housing and Urban Development Greensboro, NC 27401	Insured housing loans and minimum property standards.
N.C. Department of Insurance Wake County Courthouse Raleigh, NC	Building codes and code enforcement.
N.C. Manufactured Housing Institute Suite 211 3900 Barrett Drive Raleigh, NC 27609	Mobile home manufacturers, mobile homes supply Information on average cost, average lot rent, suggested mobile home park regulations.
Rural Electrification Authority N.C. Department of Commerce Raleigh, NC	Electricity supply.
Soil Conservation Service State Office Federal Building Raleigh, NC 27601	Soil and water conservation, soil analysis for suitability for housing.
North Carolina State Government, Raleigh, NC Division of Health Services	Water and sewer sanitation for systems.
Water and Air Resources, Ground Water Division	Counseling service on water quality and quantity
North Carolina State University Raleigh, NC 27607	
School of Design	
Landscape Architecture Program	Site planning.
Extension	
Center for Urban Affairs and Community Services	Referral service.
N. C. Agricultural Extension Service	
Extension Agronomy	Suitability of soil for house foundations, sewage disposal, management and other soil related problems.
Extension Biological & Agricultural Engineering	Water systems and farm building plans.
Extension Forestry	Forest products, recreation, raforestation, and trees for building sites.
Extension Horticulture	Lawns, trees and shrubs.
Extension Housing and House Furnishings	Stock house plans and technical information on planning, building and remodeling houses.
Veterans Administration Winston-Salem, NC	Guaranteed housing loans for veterans.

references

Water Supply

N. C. Department of Natural and Economic Resources, Ground Water Division:

Bulletin
1—*Geology and Ground Water Resources in Wilmington-New Bern Area, 1960*
2—*Geology and Ground Water Resources in Goldsboro*
3—*Geology and Ground Water Resources in Fayetteville Area, 1960*
4—*Geology and Ground Water Resources in Swan Quarter Area, 1964*
5—*Geology and Ground Water Resources in Monroe Area, 1965*
6—*Geology and Ground Water Resources in Southport-Elizabethtown Area, 1965*
7—*Geology and Ground Water Resources in the Durham Area, 1966*
8—*Geology and Ground Water Resources in the Waynesville Area, 1966*
9—*Geology and Ground Water Resources in the Martin County Area*
10—*Geology and Ground Water Resources in Hertford-Elizabeth City Area, 1966*
11—*Geology and Ground Water Resources in Cleveland County, 1966*
12—*Geology and Ground Water Resources in Morganton Area, 1967*
13—*Geology and Ground Water Resources in Murphy Area, 1968*
14—*Geology and Ground Water Resources in Chowan County, 1968*
15—*Geology and Ground Water Resources in Raleigh Area, 1968*
16—*Geology and Ground Water Resources in Asheville Area, 1970*
17—*Geology and Ground Water Resources in New Hanover County*
18—*Geology and Ground Water Resources in Pitt County, 1970*
19—*Geology and Ground Water Resources of Northwestern North Carolina, 1971*
47—*Progress Report on Ground Water in North Carolina, 1945*
51—*Geology and Ground Water in Halifax Area, 1946*
55—*Geology and Ground Water in the Greensboro Area, 1943*
59—*Flood-Plain Deposits of North Carolina Piedmont*
63—*Geology and Ground Water in the Charlotte Area, 1952*
68—*Geology and Ground Water in the Statesville Area, 1954*
73—*Geology and Ground Water in the Greenville Area, 1959*

Circular
1—*Rutherford College*
2—*Beaufort County*
3—*Clinton Area, 1964*
4—*Tanglewood Park, 1964*
5—*South School Area, Iredell*
6—*Clyde Area, 1965*
7—*Surf City*
8—*Liberty Area*
9—*Hays Area*
10—*Kinston Area*
11—*Bostic Area*
12—*Broadway Area*
13—*Ground Water Levels in North Carolina in 1963-64, 1970*
14—*Well records and other basic ground water data, Craven County, 1970*
15—*Ground Water Quality in Stanly County, 1970*

Report of Investigation—
No. 1 (1960)—G. W. Supply of Cape Hatteras National Seashore Area
No. 3 (1964)—Ground Water Supply for Dare Beaches
No. 4 (1968)—Part 3 Cape Hatteras Seashore Area
No. 5 (1968)—Part 4 Cape Hatteras Seashore Area
No. 6 (1968)—Part 5 Cape Hatteras Seashore Area
No. 7 (1968)—Part 6 Cape Hatteras Seashore Area
No. 8 (1968)—Ground Water Resources of Belhaven Area
No. 9 (1972)—Potential Ground Water Supplies for Roanoke Island and the Dare County Beaches, North Carolina

Summary of Report on Hydrogeology and Effects of Pumping from Castle Hayne Aquifer in Beaufort County, North Carolina, 1971

North Carolina Well Construction Regulations and Standards, 1971

Water Levels in Selected Observation Wells in North Carolina, 1971

Progress Report on Ground Water in North Carolina, 1945, by M. J. Mundorff

U. S. Department of Agriculture:

Water Supply Sources for the Farmstead and Rural Home. 1971. Farmers Bulletin No. 2237

Treating Farmstead and Rural Home Water Systems. Farmers Bulletin No. 2248

North Carolina Board of Health, Sanitary Engineering Division:
Protection of Private Water Supplies

Soils

United States Geological Survey, Distribution Section, 1200 South Eads St., Arlington, VA 22202
U. S. Geological Maps, 75¢

U. S. Department of Agriculture, Soil Conservation Service:
Guide for Sediment Control
Know the Soil You Build On, Agricultural Information Bulletin No. 320

U. S. Department of Health, Education and Welfare:
Manual of Septic-Tank Practices. Public Health Service Publication No. 526. Superintendent of Documents, 35¢.

N. C. Department of Natural and Economic Resources or N. C. Division of Health Services, Sanitary Engineering Section:
Residential Sewage Disposal Plants: How to Build and Maintain Them. Bulletin No. 519.
Specifications for a Pit Privy, Revised 1958.

U. S. Department of Agriculture
Foundations for Farm Buildings, Revised 1965. Farmers Bulletin No. 1869.

Trees and Shrubs

N. C. Agricultural Extension Service:
Landscaping Your Living Space, Circular No. 392, 1974.

Housing Research

Housing Research & Development, Miscellaneous Extension Publication No. 70. By Henry Sanoff, Henry Burgwyn, John Adams, Michael McNamara. North Carolina State University at Raleigh.